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(54) Computer program product for configuring network devices and an associated method for providing configuration information

Computerprogrammprodukt zur Konfigurierung von Netzwerkgeräte und eine verwandte Methode zur Lieferung von Konfigurationsinformationen

Produit-programme pour configurer des dispositifs de réseau et méthode associée pour fournir des informations de configuration

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Description

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[0002] This application is related to US-A-5819042 filed on even date herewith, entitled METHOD AND APPARATUS FOR GUIDED CONFIGURATION OF UNCONFIGURED NETWORK AND INTERNETWORK DEVICES", assigned to the Assignee of the present application.

[0003] This application generally relates to computer networks and internetworks and, more particularly, to a configuration manager which, from a central location, provides configuration information to remote devices included in a computer network or internetwork.

[0004] Generally speaking, a network is a collection of user devices, generally classified as data terminal equipment (or "DTE"), interconnected for bi-directional exchanges of information. For example, visual displays, computer systems and office workstations are all electronic devices classified as DTEs. A local area network (or "LAN") is an interconnection of plural computer systems distributed around a single site. A wide area network (or "WAN") is an interconnection of plural computer systems located at different sites. Traditionally, computer systems have used modems to connect to a WAN via the public switched telephone network (or "PSTN") or public switched data network (or "PSDN"). In recent years, WANs which utilize integrated services digital networks (or "ISDNs"), which enable data to be transmitted without modems, to interconnect computer systems have become more common. Finally, an internetwork is a collection of networks interconnected by a WAN.

[0005] Devices are initially unconfigured when delivered by the factory. Configuration is a process during which the hardware and software of an unconfigured device is organized and interconnected so that the configured device will be able to perform the tasks desired thereof. As is well appreciated in the art, the wide variety of devices which may be installed on a network, as well as the variety of networks which may be connected to form an internetwork, makes the configuration of networks and internetworks a difficult task which requires highly detailed technical knowledge of the various networks, the protocols used to link with the various networks and the devices to be installed thereon. Thus, configuration of network devices is often one of the most daunting tasks facing a network administrator, particularly for those in charge of small and medium size networks having between 100 and 1,000 nodes. While such networks are relatively complex, their administrators often have only minimal training in internetworking administration and may be unfamiliar with routing technology and/or WAN technology.

[0006] For example, data link protocols are used to control access to networks. A LAN typically uses the logical link control (or "LLC") subclass of the high-level data link control (or "HDLC") protocol as its data link protocol. However, an X.25-type packet-switching WAN uses link access procedure, balanced (or "LAPB"), a protocol based on HDLC, as its data link protocol. The data link protocol for an ISDN-type WAN, on the other hand, may either be a connection-orientated protocol known as frame switching or a connectionless protocol known as frame relay.

[0007] Even when configuration information is available, further complications problems arise when transporting the configuration information to a network device. For example, in order to communicate with a remotely located network device, a network administrator needs to know where to send the information. However, that knowledge typically resides in the configuration information for the network device. Thus, the network administrator is constrained as to what information may be delivered to the network device until after the device is configured but, until the device is configured, much of the configuration information is undeliverable. While techniques for transporting information to an unconfigured device using a limited amount of configuration information exist, inconsistencies in such information often complicate the task of transferring information using such techniques.

[0008] Thus, it can be readily seen from the foregoing that it would be desirable to simplify the task of configuring a remotely located network device. It is, therefore, the object of this invention to provide a configuration manager and an associated method of configuring a remote network device from a central location.

[0009] EP 0490624 discloses a computer program product as set out in the preamble of claim 1.

[0010] According to a first aspect of the present invention, such a computer program product is characterized by the features set out in the characterizing part of claim 1.

in that the at least one configuration script constructs a bootptab file for a first specified type of network device which is suitable for identifying said network device wherein the bootptab file is used to assist with remote configuration of the network device; in that said first software module constructs said configuration file and said bootptab file by executing said series of instructions contained in said configuration script;

55 by a second software module, executable by said processor subsystem, for processing a configuration request issued by said network device by identifying said network device using said constructed bootptab file and configuring said network device by uploading said constructed configuration file thereto; and

in that said configuration script further comprises a first section containing a series of configuration commands

which generate requests for information and a second section containing a set of connection rules for connecting said first specified type of network device to at least one other specified type of network device; and wherein said second section of said configuration script includes at least (i) an identifier for each connection interface of said first specified type of network device and (ii) a list of network device types that can be connected to the connection interface associated therewith, said list being provided for each of said identifiers.

[0011] Preferably, the second section of the configuration script includes a first portion which uniquely identifies the network device and a second portion which identifies devices installed in the network device. Preferably, the first section of the configuration script includes a first portion which corresponds to each of the at least one other specified type of network device specified in the connection rules contained in the second section of the configuration script. Each such portion contains a subset of the series of configuration commands contained in the first section of the configuration script and each such subset of configuration commands are executed only if the network device for which the configuration file is being constructed is connected to a network device of the other specified type of network device.

[0012] According to a second aspect of the present invention as set out in claim 5, there is provided a method for configuring a remotely located network device, the method comprising the steps of:

- 15 providing a configuration script containing a series of executable instructions for constructing a configuration file for a first specified type of network device;
- constructing a configuration file by executing said series of instructions contained in said configuration script; characterised by the further steps of
- 20 detecting a request for configuration issued by a network device;
- determining if said configuration file corresponds to said network device issuing said request for configuration; if said configuration file corresponds to said network device, issuing a reply which identifies said configuration file to said network device; and
- 25 issuing said configuration file to said network device in response to a request for configuration file which identifies said configuration file;

wherein the configuration script includes a first section containing a series of configuration commands and a second section containing a set of connection rules for connecting said first specified type of network device to at least one other specified type of network device, and where said second section of said configuration script includes at least (i) an identifier for each connection interface of said first specified type of network device and (ii) a list of network device types that can be connected to the connection interface associated therewith, said list being provided for each of said identifiers. Preferably, a determination of whether the configuration file corresponds to the network device issuing the request for configuration is accomplished by determining if the network device issuing the request for configuration has an identification code which matches an identification code contained in the bootptab file and determining if devices installed in the network device issuing the request for configuration match the installed devices identified in the bootptab file.

[0013] The provided configuration script may also include a second section containing a set of connection rules for connecting the first specified type of network device to at least one other specified type of network device. Within the second section, a first portion corresponding to each of the at least one other specified type of network device specified in the connection rules contained in the second section of the configuration script may also be provided. Each first portion contains a subset of the series of configuration commands which are executed only if the network device for which the configuration file is being constructed is connected to a network device of the other specified type of network device.

[0014] The present invention may be better understood, and its numerous objects, features and advantages will become apparent to those skilled in the art by reference to the accompanying drawing, in which:

- FIG. 1A is a simplified block diagram of a computer system on which a network device configuration tool may be installed;
- FIG. 1B is a block diagram of a network device configuration tool constructed in accordance with the teachings of the present invention;
- 50 FIG. 2A is a block diagram of a configuration scripts portion of the network device configuration tool of FIG. 1;
- FIG. 2B is an expanded block diagram of an attributes section of a configuration script of FIG. 2A;
- FIG. 2C is an expanded block diagram of a bitmap section of a configuration script of FIG. 2A;
- FIG. 2D is an expanded block diagram of a bitmap menu section of a configuration script of FIG. 2A;
- 55 FIG. 2E is an expanded block diagram of a guided configuration section of a configuration script of FIG. 2A;
- FIG. 3A is a flow chart of a method for guiding configuration of a network device in accordance with the teachings of the present invention;
- FIG. 3B is a flow chart of a map edit section of the flow chart of FIG. 3A;

FIG. 3C is a flow chart of a guided configuration subsection of the flow chart of FIG. 3B;
 FIG. 3D is a flow chart of a method for determining whether a pair of network devices are connectable;
 FIG. 4 illustrates a configuration manager GUI for constructing a map of configured network devices with a pre-constructed network configuration map in a network workspace portion thereof;
 5 FIG. 5 illustrates an exemplary guided configuration GUI for constructing a configuration script for a network device;
 FIG. 6 illustrates a backplane bitmap for a configured network device;
 FIG. 7 illustrates the configuration manager GUI of FIG. 4 with a preconstructed network configuration map modified to include newly added and configured devices thereon;
 10 FIG. 8 is a flowchart of a method of configuring a remote network device in accordance with another aspect of the present invention; and
 FIG. 9 illustrates a pop-up bootP GUI in which an unconfigured network device is requesting configuration information.

[0015] Referring first to FIG. 1A, a computer system 2 suitable for installing a network device configuration tool thereon may now be seen. The computer system 2 is comprised of a processor subsystem 4, for example, a type P6 Pentium processor manufactured by Intel Corporation of Santa Clara, California, coupled to a memory subsystem 6, for example, a hard drive or other auxiliary memory device capable of storing large amounts of data infrequently used by the processor subsystem 4, by a system bus 8, preferably, a 32-bit wide peripheral connection interface (or "PCI") bus. Also coupled to the system bus 8 is a user interface 9. Commonly, the user interface is comprised of three peripheral devices--a video display, a keyboard and a pointing device.
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[0016] Referring now to FIG. 1B, a network device configuration tool 10 constructed in accordance with the teachings of the present invention will now be described in greater detail. The network device configuration tool 10 is graphical user interface (or "GUI") based software launchable from a suitable platform installed on the computer system 2. For example, Windows 95 and Windows NT 3.51, both manufactured by Microsoft of Redmond, WA, are suitable platforms
 20 from which the network device configuration tool 10 may be launched.
 25

[0017] In its broadest sense, the network device configuration tool 10 provides a GUI in which the so-called "drag and drop" process is used to construct a network configuration map comprised of a series of interconnected network devices and/or network entities, for example, a LAN, WAN or other network, from a combination of user inputs, network configuration maps, configuration scripts and local configuration files.
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[0018] In constructing the network configuration map, a series of local configuration files are constructed for the network devices and appended to the network configuration map. The local configuration files contain information, for example, internet protocol (or "IP") address, default gateway, router name and simplified network management protocol (or "SNMP") community strings, necessary for the network device, for example, a router, to properly communicate on the network.
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[0019] For each network device for which a local configuration file has been constructed, the network device configuration tool 10 may also construct a network device configuration file suitable for export to the network device itself. In this manner, remote configuration of network devices is enabled.
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[0020] As shown in FIG. 1B, the network device configuration tool 10 may be representatively illustrated as being comprised of two software modules, map editor 14 and configuration guide 18, both of which are executable by the processor subsystem 4, which retrieve data and programming instructions from various locations within the memory subsystem 8 of the computer system 2 on which the network device configuration tool 10 is installed.
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[0021] The data and programming instruction are stored in the memory subsystem 6 as a series of files which may be selectively accessed by the map editor 14 and/or the configuration guide 18. Files which are accessible to the map editor 14 and/or the configuration guide 18 are configuration scripts 12, map files 16, local configuration files 20 and network configuration files 22. The configuration scripts 12 identify the types of network devices and network entities which may be placed on the network configuration map and interconnected with other network entities and network devices. The configuration scripts 12 also identify the network devices which are configurable by the network device configuration tool 10 and contain information necessary to construct configuration files for those network devices. If a particular network device does not have a configuration script, a configuration file cannot be constructed by the network device configuration tool 10. The map files 16 contain a series of network configuration maps, each comprised of a series of interconnected network devices and network entities, constructed using the network device configuration tool 10. The local configuration files 20 contain information which, if uploaded to the corresponding network device 26, would enable configuration of that device. If local configuration files 20 are constructed for the network devices illustrated on the network configuration map(s) 16 produced using the network device configuration tool 10, such local configuration files 20 are associated with the corresponding network device such that they may be directly accessed from the network configuration maps 16.
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[0022] The network configuration files 22 are similar in content to the local configuration files 20 except that the files have been formatted for upload to a network device 26 coupled to the configuration tool in a manner to be more fully
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described below. Broadly speaking, a local configuration file 20 is modified for upload to the corresponding network device 26 by formatting the local file into the appropriate IP address for the target network device 26. Finally, the network device configuration tool 10 includes a reverse parser 24 coupled to the local configuration files 20 and the network configuration files 22. The reverse parser 24 is used to construct a local configuration file 20 from a network configuration file 22 downloaded to the network configuration tool 10 by the network device 26.

[0023] It is contemplated that the network device configuration tool 10 would be installed in the computer system 2 operated by a network administrator and that plural network devices 26 and other network entities, only one of which is shown in FIG. 1B for ease of illustration, would be coupled to the network device configuration tool 10. Utilizing the network device configuration tool 10, the network administrator may build a representative network configuration map 10 for the network. The network administrator may then configure remotely located network devices by uploading configuration files constructed during the process of building the network configuration map to the devices. Thus, by using the network configuration tool, the network administrator can, from a central location, design a suitable configuration network and then configure any number of remotely located devices included in the network.

[0024] The network device configuration tool 10 is coupled to the network device 26 by an asynchronous interface 28 and a boot protocol (or "bootp")/trivial file transfer protocol (or "TFTP") manager 30. Under the control of an asynchronous manager (not shown), a software process within the processor subsystem 4, the asynchronous interface 28 is used to exchange configuration information, for example, a network configuration file 20, by either an in-band transfer via in-band connection 29a, for example, via telnet, or by an out-of-band transfer via out-of-band connection 29b, for example, via modem. Additionally, the bootp/TFTP manager 30, another software process within the processor subsystem 4, controls the exchange of bootp and TFTP messages between the network device configuration tool 10 and the network device 26. Generally, a bootp exchange is used to transfer raw address and other basic information so that a TFTP exchange may then be used to transfer configuration information. The bootp/TFTP manager 30 also controls accesses to bootptab files 32.

[0025] As will be more fully described with respect to FIG. 3, below, the configuration scripts 12 are used to direct map editor 14 and configuration guide 18 in a guided configuration of a selected network device 26 by guiding in the construction of a configuration file for the device. Accordingly, turning momentarily to FIG. 2A, the configuration scripts 12 used to guide the configuration of a selected network device 26 will now be described in greater detail. As may now be seen, the configuration scripts 12 are comprised of a series of separate scripts 12-1 through 12-N, one for each type of device which may be configured by the configuration tool 12. Each script 12-1 through 12-N is comprised of an attributes section 34, a bitmap section 36, a bitmap menu section 38 and a guided configuration section 40. Each of these sections 34, 36, 38 and 40 is a selectively executable set of commands which may be used during configuration of a device of the type corresponding to a particular script 12-1 through 12-N.

[0026] Turning now to FIG. 2B, the attributes section 34 is comprised of an icon portion 34a, a network entity portion 34b, a description portion 34c and a series of connection portions 34d-1 through 34d-N. A valid icon filename identifying the graphical icon to be associated with the device type corresponding to the configuration script 12-N is contained in the icon portion 34a. As will be more fully described below, this icon will appear in a device window of a configuration GUI and can be dragged onto a network workspace to add a device of that type to a network configuration map. The network entity portion 34b provides a unique name for the type of device and appears in the device window under the icon. The description portion 34c defines a default description for the device which pre-populates the dialog box when a device type is dragged onto the network workspace. Finally, the connection portions 34d-1 through 34d-N provides connection statements for the device type. Specifically, a connection portion 34d will be provided for port, modular slot or other type of connection interface for the device type. Each connection statement will include a physical name for the port or other type of connection interface and the network entity names for all other types of devices which may be connected to the port. For example, if the network device was a modular router having 4 PCI slots, each connectable to ethernet, X.25, frame relay, PPP and ISDN type entities, and an ethernet port connectable to an ethernet entity, the attributes section 34 could be as set forth in the following code:

```
:ATTRIBUTES
ICON ROUTER.ICO
50 NETENTITY "Compaq Router"
DESCRIPTION "Modular and Fast"
CONNECT "PCI SLOT 1" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "PCI SLOT 2" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "PCI SLOT 3" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
55 CONNECT "PCI SLOT 4" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "Ethernet Port" "Ethernet"
©1995 Compaq Computer Corporation
```

5 [0027] Turning next to FIG. 2C, the bitmap section 36 defines the "drill down" bitmap which is presented to the network administrator upon requesting subsequent configuration of a configured network device. The bitmap section 36 also defines any necessary overlay bitmaps as well as provides the locations of "hot spots" on the bitmap. The bitmap is a graphical representation of the backplane of the configured device which provides connection information for the ports thereof. "Hot spots" on the bitmap are paths to additional information related to the connected ports for the configured network device.

10 [0028] Bitmap file portion 36a names a valid window bitmap format file which will be displayed in its own window when the network administrator double clicks on a configured network device. For each connected port of the configured network device, the bitmap section 36 will also include a location port portion 36b-1 through 36b-N which provides the location of the hot spot for the connected port on the bitmap. Finally, the bitmap section includes an overlay device bitmap file 36c-1 through 36c-x for each type of network device or entity which is connectable to the configured network device. Then, if the configured device is connected to that particular network entity, the network entity can be represented on the bitmap.

15 [0029] For example, if the bitmap 36 is comprised of a bitmap file 36a, port locations 36b-1 and 36b-2 and overlay device file 36c-1 as set forth in the sample code below:

```
BITMAP "router.bmp"
LOCATE "Slot 1" 20 40
LOCATE "Port 1" 50 90 70 120
20 OVERLAY "Ethernet" "TLAN.BMP"
©1995 Compaq Computer Corporation
```

25 [0030] The bitmap 36 will include a representation of an ethernet-type network entity stored at TLAN.BMP drawn on top of the representation of a backplane of a router stored at ROUTER.BMP at coordinates 20, 40 if the "Ethernet"-type network entity is plugged into "Slot 1".

30 [0031] The bitmap menu section 38 defines a menu hierarchy presented to the user for hot spots, for example, connected slots, on the bitmap and the executable commands for each item included in a command menu. The command menu is displayed when the network administrator clicks on a connected slot on the bitmap. The bitmap menu section 38 is subdivided into network entity command sections 38a-1 through 38a-x. Specifically, for each network entity for which connection to the device is allowed, a corresponding network entity command section is provided such that, if that network entity is connected to the device, the commands defined in the section will be displayed to the network administrator for selective execution thereof.

35 [0032] The guided configuration section 40 defines the GUIs used to guide a user through configuration of a device and controls the configuration file to be constructed using user responses to the GUIs. As illustrated in FIG. 2D, the guided configuration section 40 is subdivided into a general script command portion 40a and a port script command portion 40b-1 through 40b-N for each port to which the device is connectable. A guided configuration script for a Cisco 2514 router is set forth in Appendix A by way of example and will be described in greater detail with respect to FIGS. 3-D, below.

40 [0033] Returning now to FIG. 1B, the network device configuration tool 10 will now be described in greater detail. Generally, the map editor 14 controls the generation of a map of a network configuration while delegating the task of configuring unconfigured devices placed on the network configuration map to the configuration guide 18. Upon initiation of the configuration process, the map editor 14 selectively retrieves a map file 16, or creates a blank map, for editing. To add a device of a selected type to the network configuration map, the map editor 14 retrieves the corresponding configuration script 12-N from the configuration scripts 12 and, using the information contained in the retrieved configuration script 12-N places an unconfigured device of the selected type on the network configuration map and appends a name for the device to the map. The map editor 14 performs all operations in which editing of the network configuration map is proposed. For example, if a connection between two devices placed on the network configuration map is proposed, the map editor 14 reviews the configuration scripts 12 for the devices and, if a connection between the two devices is permitted, the map editor 14 completes the proposed connection and appends the connection information to the network configuration map.

45 [0034] If a request to configure a device placed on the network configuration map is received, the map editor 14 transfers the name and connection information for the device to the configuration guide 18 and instructs the configuration guide 18 to perform the requested configuration task. For example, if configuration of a network device is requested, the configuration guide 18 will retrieve the configuration script 12-N for that type of network device and execute the instructions contained in the guided configuration section 40 thereof. Using the information provided by the configuration script 12, the map editor 14 and input provided by the network administrator in response to execution of the instructions contained in the guided configuration section 40, the configuration guide 18 builds a local configuration file, associated with the device, for use by the network administrator and a corresponding network configuration file

suitable for upload to the network device to enable configuration of the network device.

[0035] Referring next to FIG. 3A, the method for guiding configuration of a network device by constructing a configuration file for the network device which is the subject of the present invention shall now be described in greater detail. It should be clearly understood, however, that the illustrated order of steps is purely exemplary and should not be construed as limiting the scope of the invention. The method commences at step 42 by launching the network device configuration tool 10 from a platform such as Windows '95 by selecting an icon previously designated as providing a path to the network device configuration tool 10.

[0036] Proceeding to step 44, once launched, the network device configuration tool 10 generates a configuration manager GUI 100 (see FIG. 4) which provides a network workspace 102 and a device window 104. In the network workspace 102, a map comprised of any number of interconnected network devices, each having a configuration tied thereto, may be produced. The device window 104, on the other hand, displays all of the types of network devices which may be placed on the network workspace 102. Continuing on to step 46, for each type of network device for which a configuration script 12-N has been prepared and stored in the memory subsystem 6, the network device configuration tool 10 places an icon representative of the network device type in the device type window 104 to indicate to the user which types of network devices are configurable by the network device configuration tool 10. For example, the device window 104 illustrated in FIG. 4 includes icons representative of a PPP link, a vendor specific modular router, an ISDN-type WAN, an Ethernet-type LAN, a non-vendor specific computer subsystem, an X.25-type packet-switching WAN, and an ISDN-type WAN which subscribes to frame relay-mode service. At step 48, the network device configuration tool 10 loads a blank map into the network workspace 102. At this stage, the network device configuration tool 10 has completed loading the configuration manager GUI 100 and is ready to execute selected commands in response to inputs received from the network administrator via the user interface 9.

[0037] Proceeding on to step 50, the network administrator selects a command, either from one of the pull-down menus listed on the pull-down menu bar 108 or by depressing a command button displayed on command button bar 110. The menus displayed on the pull-down menu bar 108 are "file", "edit", "network", "window" and "help". By selecting one of these menus, a series of commands, each of which relates to the selected menu, are displayed. Available file commands are "new", "open", "save", "save as", "print", "print setup" and "exit". The new command clears the network workspace 102 of any network configuration map placed thereon. The open command allows the network administrator to select a network configuration map to be placed on the network workspace 102. The save and save as commands stores the map placed on the network workspace 102 to the memory subsystem 6. The print command prints the network configuration map placed on network workspace 102. The print setup command displays the printer configuration for the computer system 10. The exit command closes the network configuration tool.

[0038] Commands available under the edit menu are "draw mode", "move mode", "workspace properties", "edit device", "view/configure device", "delete device", "all ports connected configuration", "update configuration", "retrieve configuration", "associate configuration", "telnet to this device". The draw mode command allows the network administrator to draw connections between devices displayed on the network workspace 102. The workspace properties command is, in fact, a second pull-down menu which allows the network administrator to tailor the map placed in the network workspace 102. Commands available under the workspace properties menu are "view entity name", "view entity description", "view entity connections", "view ip addresses", "view ipx addresses", all of which add the listed information to the display of each device on the map, and the "snap to grid" and "view grid", both of which orientate the map to a grid.

[0039] The edit device command accesses the configuration information associated with a selected network device. The view/configure command displays a view of the backplane of a selected configured network device or, if the selected network device is unconfigured, defaults to the configuration dialog set forth in greater detail below. The delete device command removes a selected network device or entity from the network workspace. The all ports configured, update configuration provides access to a selected device's configuration file. The retrieve configuration file allows the network administrator to directly access a configuration file stored in the memory subsystem 6 while the associate configuration command permits the network administrator to append a configuration file to a device. The telnet to the device command initiates an in-band transfer of configuration information from the network device configuration tool 10 to the network device 26.

[0040] Commands available under the network menu are "bootptab maintenance", "enable bootp server", "disable bootp server", "enable TFTP server", "disable TFTP server" and "view network activity log". All of these commands are relate to the exchange of configuration information between the network device configuration tool 10 and the network device 26. More specifically, the bootptab maintenance command enables the network administrator to review previously constructed bootptab files 32. The enable/disable bootp server commands control the operation of the computer system 2 on which the network device configuration tool 10 operates as a bootp server, i.e. is capable of sending and/or receiving bootp messages via the bootp/TFTP manager 30. When enabled as a bootp server, the computer system 2 listens for bootp requests placed on the network by devices requesting configuration information. The enable/disable TFTP server commands control operation of the computer system 2 on which the network device configuration

tool 10 operates as a TFTP server, i.e. is capable of sending and/or receiving TFTP messages via the bootp/TFTP interface 30. Finally, the view network activity log provides a historical display of exchanges between the network device configuration tool 10 and network devices requesting configuration.

5 [0041] Commands under the window menu are "arrange", "configuration files" "workspace", "requesting router" and "network devices". The arrange command is a pull-down menu which provides a set of commands which modify the appearance of the configuration management GUI 100. The configuration files command displays the configuration files stored in the memory subsystem. The workspace and network device commands respectively move the network administrator to the network workspace 102 and the device window 104. Finally, the requesting router command provides a list of network devices 26 requesting IP addresses and configuration files from the network device configuration 10 tool 10.

[0042] The command button bar 110 provides immediate execution of selected commands available from the pull-down menus 108. The commands which may be executed from the command button bar 110 are new, open, save, print, draw mode, move mode, network devices, workspace, requesting router, view network activity log and help.

15 [0043] Proceeding to step 52, the network administrator executes the command selected at step 50. For example, if the network administrator decides to retrieve an existing network configuration map stored in memory, the network administrator may click on the "open map" command button on the command button bar to display a list of map files 16 stored in memory and then select a map file to be opened. An exemplary network configuration map 106 which may be stored in memory is illustrated in FIG. 4. The network configuration map 106 is comprised of a vendor specific device 112, here, a modular router manufactured by Compaq Computer Corporation of Houston, Texas, having a first peripheral connection interface (or "PCI") slot coupled to a first ethernet-type LAN 114, a second PCI slot coupled to a second ethernet-type LAN 116, a third PCI slot coupled to a frame relay-type WAN 118 and an ethernet port coupled to a third ethernet-type LAN 120.

20 [0044] Continuing on to step 54, the network administrator then decides whether to edit the network configuration map 106 displayed in the network workspace 102. If the network administrator decides not to edit the network configuration map 106, the method proceeds to step 56 where the network administrator decides whether to execute another command. If so, the method returns to step 56. Otherwise, the network administrator closes the network configuration tool at step 58 to end the method.

25 [0045] Returning now to step 54, if the network administrator decides to go to the network workspace 102 to edit either the blank map initially loaded into the network workspace 102 at step 48 or, if a saved map was retrieved from the map files 16 by executing an "open file" command at step 52, the retrieved map loaded into the network workspace at step 52, the method proceeds to step 59 (FIG. 3B) where the network administrator decides whether to edit the map displayed in the network workspace 102. If the network administrator decides not to edit the map, the method returns to step 56 (FIG. 3A). If, however, the network administrator decides to edit the configuration network map 106 displayed in the network workspace 102 the method proceeds to step 60 where editing of the map commences.

30 [0046] At step 60, the network administrator may select a device type displayed in device type window 104 and add a device of the selected type to the map 106 displayed in network workspace 102. Proceeding to step 62, to add a device of a type displayed in the device type window 104 to the network configuration map 106 displayed in the network workspace 102, the user selects an icon representing a desired device type and, using the "drag and drop" process, places the icon on the network configuration map 106 displayed in the network workspace 102. For example, using a mouse or other conventional pointing device, the user would point to an icon representing the desired device type, select the device type by holding a leftmost button on the mouse in the depressed position, point to the desired position on the map and release the button. By doing so, a new device of the selected type is added to the network map. For example, in FIG. 7, a single network device, i.e., a modular router 122 manufacture by Compaq Computer Corporation, and a pair of network entities, i.e., ethernet type LANs 124 and 126 have been added to the network configuration map 106.

45 [0047] Each network device and/or network entity added to the network configuration map 106 is associated with a corresponding one of the configuration scripts 12-N. Accordingly, at step 64, the map editor 14 displays the name of the network device or entity contained in the attributes section 34 of the corresponding configuration script 12-N as the name of the newly added network device or entity. For example, the name of the network device 122 added to the network configuration map 106 is "Compaq Router".

50 [0048] Upon placing the, as yet unconnected, network device 122 and entities 124, 126 on the network configuration map 106, or if it was decided at step 60 to not add a network device or entity to the network configuration map 106, the method proceeds to step 66 where the network administrator decides whether to connect the newly added network devices and entities 122, 124 and 126 to other network devices or entities. For example, the network administrator 55 may decide to connect the Compaq router 122 to the frame relay-type WAN 118, the ethernet-type LAN 124 and the ethernet-type LAN 126. If the network administrator decides to connect the Compaq router 122 to the ethernet-type LAN 124, the method proceeds to step 68 where the network administrator would select the Compaq router 122 by holding a leftmost button on the mouse in the depressed position while pointing to the Compaq router 122, draw a

connection between the Compaq router 122 and the ethernet-type LAN 124 by repositioning the mouse to point at the ethernet-type LAN 124 while the button is depressed and releasing the button to complete the connection.

[0049] Continuing on to step 70, the map editor 14 determines whether the proposed connection is permissible. If the proposed connection is permitted, the line drawn by the network administrator is completed at step 72. The connection interface(s) for the origination device are then placed on the network configuration map 106 and the method continues on to step 74 for further editing of the network configuration map 106. For example, as shown in FIG. 7, PCI slot 1 of the Compaq router 122 has been used to connect the device to the ethernet-type LAN 126, PCI slot 2 to connect to the frame relay-type WAN 118 and PCI slot 4 to connect to the ethernet-type LAN 124. If, however, the proposed connection is not permitted, the line drawn by the user is deleted at step 76 before continuing on to step 74.

[0050] Returning to step 70, the method by which the map editor 14 determines whether the proposed connection is permitted will now be described in greater detail. An initial determination as to whether the proposed connection is permissible is made based upon the contents of the attributes section 34 of the configuration scripts 12-N for the devices placed on the map 106. For example, the configuration script for a Cisco 2514 router is set forth in the attached appendix. A portion of the attributes section of the configuration script contains the following code:

```

15      CONNECT "ETHERNET0" "Ethernet"
      CONNECT "ETHERNET1" "Ethernet"
      CONNECT "SERIAL0" "X.25" "Frame Relay" "PPP" "HDLC"
      CONNECT "SERIAL1" "X.25" "Frame Relay" "PPP" "HDLC"
20      ©1995 Compaq Computer Corporation

```

This portion of the configuration script code contains considerable connection information for the device. Specifically, the device has four connection interfaces--two ethernet ports and two serial ports. Furthermore, the two ethernet ports are only connectable to an ethernet-type LAN entities device while the two serial ports are connectable only to X.25, frame relay, PPP and HDLC entities. Accordingly, at step 70, the mapper compares the list of network device or entity types which are connectable for the two devices and/or entities for which connection is proposed. If the devices and/or entities are connectable, the method proceeds to step 72 where connection of the two devices and/or continues.

[0051] Turning momentarily to FIG. 3D, the step of connecting the two devices and/or entities will now be described in greater detail. The method commences at step 150 and continues on to step 152 where the configuration file for the origination device or entity is reviewed to determine if the origination device or entity has an available slot which is connectable to the destination device or entity and to step 154 where the configuration file for the destination device or entity is reviewed to determine if the destination device or entity has an available slot which is connectable to the origination device or entity. If either the origination or destination device or entity do not have an available slot which is connectable to the other device or entity, a determination is made at step 156 that the devices/entities cannot be connected. The proposed connection is then deleted at step 158 and, continuing on to step 166, the method returns to step 72.

[0052] Returning to step 154, if it is determined that both the origination and destination devices or entities have available slots, the method proceeds to step 160 where a connection interface is selected for the originating device and on to step 162 where a connection interface is selected for the destination device or entity. At both of these steps, the network administrator may select any one of a list of available connection interfaces overlayed on the network configuration map 106 by the network device configuration tool 10. If only one connection interface is available for a device or entity, however, the map will automatically select the available interface and indicate its selection of the connection interface to the network administrator. Upon selecting connection interfaces for the devices or entities, the method proceeds to step 164 where the selected connection interface for the device 122 is displayed on the network configuration map 106 and on to step 166 for a return to step 72.

[0053] Upon either a decision not to connect devices or entities at step 66, a completion of a proposed connection at step 72 or a deletion of a proposed connection at step 76, the method proceeds to step 74 where the network administrator decides whether to configure a device. To initiate configuration of a selected unconfigured device, the network administrator double clicks on the device to be configured. At step 78 (FIG. 3C) the configuration guide 18 retrieves the guided configuration section 40 from the configuration script 12-N for the type of device to be configured and, proceeding to step 80, executes the script commands contained in the general script commands portion 40a of the guided configuration section 40. In turn, the execution of the script commands causes a series of questions to be asked of the network administrator, the answers to which are used to construct a configuration file. For example, if the script commands set forth in the guided configuration section of the configuration script set forth in Appendix A were executed during configuration of a Cisco 2514 router, the network administrator would be asked to name the router, indicate whether to configure internet protocol (or "IP") for the router, indicate which IP routing protocol should be used for the router, whether to configure IPX for the router, indicate whether the router should be password protected, choose a password for the router, indicate whether the configuration mode for the router should be password protected and

choose a password for the configuration mode.

[0054] Proceeding to step 82, the configuration guide 18 determines whether any ports of the device being configured are connected to a second device or entity. If any of the ports are connected, the method proceeds to step 84 where the configuration guide 18 executes the script commands for the connected ports. For example, if serial port 1 of a

5 Cisco router 2514 was connected to a WAN, the configuration guide 18 would execute the script commands set forth in serial portion of the script commands set forth in Appendix A. Thus, in this example, the network administrator would be asked whether the serial port should be configured, the IP address and mask for the port, the IPX network number, whether the port should be configured for frame relay, the type of connector being used for the port, the local data link connection identifier (or "DLCI"), the Committed Information Rate (or "CIR") and the Excess Information Rate (or "EIR")
10 for the port and whether to use compression.

[0055] The configuration guide 18 collects the information necessary to configure the device by engaging the network administrator in a dialog during which the configuration guide 18 generates a series of GUIs, each of which displays a request for information and provides areas in which the requested information may be inputted and buttons for guiding the network administrator through the dialogue. By way of example, an IP address GUI 200 is illustrated in FIG. 5. The
15 network administrator may input the IP address and mask for the indicated slot and device by respectively entering the IP address and mask in areas 202 and 204. The network administrator may also review a prior GUI in the dialogue by depressing button 206, proceed to the next GUI in the dialogue by depressing button 208, request help by depressing button 210 or exit the configuration dialog by depressing button 212.

[0056] Upon successful execution of the script commands for the connected ports at step 84, or if it was determined
20 at step 82 that no ports are connected for the device being configured, the configuration dialog is completed at step 86 and, at step 88, the information provided by the network administrator during the dialogue is used to construct a local configuration file 20 for the device. If desired, the network administrator may view the local configuration file 20 constructed during this process at step 90, directly edit any of the configuration commands contained therein at step 92 before saving the constructed local configuration file 20 to the memory subsystem and associating it with the device.
25

Selected portions of the configuration information contained in the local configuration file 20 may be displayed on the network configuration map 106. For example, FIG. 7 displays the IP address and mask for PCI slot 1 of the Compaq router 122 which was input by the network administrator during configuration of the device. The network configuration map 106 may also include a indicator 128, for example, a loop surrounding a device, which indicates that a device has been configured.

30 [0057] Having successfully constructed a local configuration file 20 and associated it with the device being configured, the method proceeds to step 96 (FIG. 3B) where the network administrator decides whether to upload the configuration file to the device. If upload is selected, the method proceeds to step 97 where the constructed configuration file is uploaded to the network device 26. Various mechanisms may be used to upload a constructed configuration file to the network device 26. For example, in many circumstances, an in-band transfer of the configuration file via telnet may be
35 used. In other circumstances, other mechanisms more fully described below may be necessary to transfer configuration information to the network device 26.

[0058] While constructing a local configuration file for a device, the network device configuration tool 10 also constructs a bootptab file for the device. The bootptab file is particularly useful in those situations where the network administrator decides not to upload the configuration file upon completing the construction thereof, for example, if the
40 network device is unconnected, powered down or otherwise unavailable. A bootptab file for a device contains the serial number for the device to be configured, an IP address to assign to the device to be configured and the configuration file to be uploaded to the device. As will be more fully described with respect to FIGS. 8-9, below, the bootptab file provides information necessary for unattended remote configuration of network devices as they are connected to the network.

45 [0059] Returning now to FIG. 3B, after completing upload of the configuration file at step 97, or if the network administrator decided at step 96 not to upload the configuration file, the method proceeds to step 98 where the network administrator decides whether to perform subsequent configuration on a device on the network configuration map 106. If subsequent configuration of a device is selected, the method proceeds to step 99 where subsequent configuration of a selected device is performed from a backplane bitmap of the selected device. To select a device for subsequent configuration, the network administrator double clicks on a configured device included on the network configuration map 106. By doing so, a bitmap of the backplane of the selected configured device is displayed.

50 [0060] FIG. 6 illustrates a backplane bitmap 220 for the Compaq router 122 of FIG. 7. As may now be seen, the various connection interfaces used to connect the router 122 to network entities, as well as unconnected connection interfaces, are graphically displayed on the backplane bitmap 220 using the information contained in the bitmap section 36 of the configuration script 12-N and the local configuration file 20 for the Compaq router 122. Specifically, for the Compaq router 122, PCI slot 1 has been used to provide a first ethernet connection 222, PCI slot 2, an HSSI connection 224 and PCI slot 4, a second ethernet 226. PCI slot 3, however, remains unconnected. From the backplane bitmap 220, the network administrator may view the settings for a port by double clicking on a selected port or, by depressing

the right mouse button, bring up a pull down menu of commands contained in the network entity commands section 38a-x of the bitmap menu 38 for the network entity connected to the selected port and select any of the configuration commands listed on the pull down menu for execution.

5 [0061] After completing subsequent configuration of the device at step 99, or if the network administrator decided at step 98 not to perform subsequent configuration, the method returns to step 56 (FIG. 3A).

[0062] Turning next to FIG. 8, a method of transmitting configuration information to a network device 26 in accordance with the teachings of the present invention shall now be described in greater detail. The method commences at step 250 by launching the network device configuration tool 10. As previously stated with respect to FIG. 3A, launch of the network device configuration tool 10 initiates the generation of the configuration manager GUI 100. In addition, launch 10 of the network device configuration tool 10 initiates listening, by the network device configuration tool 10 at step 252, for the presence of unconfigured network devices 26 on the network.

[0063] Proceeding to step 254, the network device configuration tool 10 will detect bootp packets transmitted on the network and determine if the bootp packet was issued by a device requesting configuration information from the network device configuration tool 10. More specifically, if an unconfigured network device 26 powers up on the network, the 15 unconfigured network device 26 will periodically issue a bootp packet which contains a medium access code (or "MAC") address for the device and a code which indicates that the device is requesting configuration information. For example, the code may be placed in the vendor specific field of the bootp packet. If a detected bootp packet does not contain a request for configuration information, the method returns to step 252 where the configuration tool continues to listen for bootp packets.

20 [0064] If, however, the network device configuration tool 10 determines at step 256 that the issuing device is requesting configuration information, for example, by matching a request code held by the network device configuration tool 10 with a corresponding code contained in the detected bootp packet, the method proceeds to step 258 where the network device configuration tool 10 will determine if the device requesting configuration information has a corresponding bootptab file 32 and if the description of the device requesting configuration information matches the device drawn 25 on the network configuration map 106.

[0065] In order to determine whether the device requesting configuration information has a corresponding bootptab 30 file 32 and if the description of the device matches the device drawn on the network configuration map, the attributes section 34 must be modified to include two additional portions--bootpid and subdeviceid. The bootpid portion contains a number unique to a particular device type and model number. The subdeviceid identifies the type of devices installed in the device. For example, if the network device was a modular router having 4 PCI slots, each connectable to ethernet, X.25, frame relay, PPP and ISDN type entities, and an ethernet port connectable to an ethernet entity with a ThunderLan board connectable to ethernet entities, a W-Adapter connectable to X.25, frame relay and PPP entities and a Basic Rate ISDN Board connectable to ISDN entities installed therein, the attributes section 34 could be as set forth in the following code:

```
35 :ATTRIBUTES
ICON ROUTER ICO
NETENTITY "Compaq Router"
DESCRIPTION "Modular and Fast"
40 CONNECT "PCI SLOT 1" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "PCI SLOT 2" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "PCI SLOT 3" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "PCI SLOT 4" "Ethernet" "X.25" "Frame Relay" "PPP" "ISDN"
CONNECT "Ethernet Port" "Ethernet"
45 bootpid 103
subdeviceid 11 "ThunderLan board" "Ethernet"
subdeviceid 12 "W-Adapter" "X.25" *2 "Frame Relay" *2 "PPP" *2
subdeviceid 13 "Basic Rate ISDN Board" "ISDN"
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```

50 The guided configuration section would be similarly modified to include an additional command script portion which, upon execution thereof, will issue any additional requests for information, for example, installed devices, necessary to construct the bootptab file described herein such that a determination as to whether the description of the device requesting configuration matches the device drawn on the network configuration map 106.

55 [0066] Proceeding to step 260, if the device requesting configuration has a matching bootptab file, i.e., the bootptab file has a bootpid which matches the serial number of a device having a bootptab file and if the devices installed in the device requesting configuration match the devices identified in the subdeviceid portion of the configuration file for the matching bootptab file, the network device configuration tool 10 issues a bootp reply at step 260. The bootp reply

contains the filename which matches the configuration file described in the matching bootptab file. Using the filename contained in the bootp reply, at step 262, the device requesting configuration may issue a TFTP request for configuration information to the network device configuration tool 10 which identifies the configuration file containing its configuration information.

- 5 [0067] Continuing on to step 264, in response to the TFTP request containing the filename of a configuration file issued by the device requesting configuration, the network device configuration tool 10 responds by issuing the requested configuration file to the device. At step 266, the unconfigured network device configures itself using the information contained in the configuration file transmitted thereto by the network device configuration tool 10 and, at step 268, the method ends.
- 10 [0068] Returning to step 258, if the device requesting configuration does not have a matching bootptab file, the method proceeds to step 270 where the network device configuration tool 10 generates a pop-up requesting device GUI 300 which overlays a portion of the configuration manager GUI 100. A requesting device GUI 300 is illustrated in FIG. 9. As illustrated herein, the requesting device GUI 300 includes an icon representing the unconfigured network device 302 requesting configuration.
- 15 [0069] Proceeding to step 272, the network administrator may select one of two options to configure the device requesting configuration. If the network administrator decides that the device 302 is a new device, the requesting device may be dropped onto the network workspace 102, thereby adding the requesting device to the network configuration map 106 as an unconnected device. Proceeding on to step 274, the method would return to step 64 (FIG. 3B) wherein the previously discussed process of constructing a configuration file and uploading the configuration file to the unconfigured network device may be completed to configure the device requesting configuration.
- 20 [0070] Returning to step 272 and, now proceeding to step 276, the network administrator may instead opt to drop the device 302 requesting configuration onto an existing device, for example, router 112, already included on the network configuration map 106. By dropping the device 302 requesting configuration onto an existing device on the network configuration map 106, the network administrator is indicating that the device 302 requesting configuration is
- 25 the same device that is already on the network configuration map 106 but, due to a difference between the description of the device 302 in the bootptab and the description of the device 112 contained in the corresponding configuration file, the network device configuration tool 10 is unable to recognize that the two are the same device.
- 30 [0071] Proceeding on to step 278, the network device configuration tool 10 would reconcile the configuration file and the bootptab file for the device. If the two are irreconcilable, the method terminates at step 280. If the two can be reconciled, the configuration file is revised appropriately at step 282 and the method then returns to step 264 so that the network device configuration tool 10 may issue the revised configuration file to the device 302 requesting configuration in the manner previously described. To reconcile the device 302 requesting configuration and an existing device such as the router 112, the network device configuration tool 10 reviews the devices installed on the device requesting configuration match the devices installed. If the installed devices match, then the configuration file is modified using the contents of the bootptab file. The method then proceeds to step 264 so that the network device configuration tool 10 may issue the revised configuration file to the device 302 requesting configuration.
- 35 [0072] Thus, there has been described and illustrated herein a configuration manager for network devices and an associated method of providing configuration information to a network device. However, those skilled in the art will recognize that many modifications and variations besides those specifically mentioned may be made in the techniques described herein without departing substantially from the concept of the present invention. Accordingly, it should be clearly understood that the form of the invention described herein is exemplary only and is not intended as a limitation on the scope of the invention as defined by the appended claims.

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55

APPENDIX "A"

5 File: 2514.DEV

:ATTRIBUTES
 ICON ROUTER.ICO
 NETENTITY "Cisco 2514"
 10 DESCRIPTION "Cisco IOS"
 CONNECT "ETHERNET0" "Ethernet"
 CONNECT "ETHERNET1" "Ethernet"
 CONNECT "SERIAL0" "X.25" "Frame Relay" "PPP" "HDLC"
 15 CONNECT "SERIAL1" "X.25" "Frame Relay" "PPP" "HDLC"

20 :GUIDED_CONFIG

use 2514vars.use
 frame
 askstring routername "What do you want to name this
 router?" minlen 2 maxlen 20
 savefilename \$routername "-config"
 addconfig "hostname " \$routername
 25
 frame
 radio configip "Do you want to configure IP on this
 router?" "Yes" "No"
 if \$configip = "Yes" then
 30 frame
 radio routeprot "What IP routing
 protocol do you want to use?"
 "RIP" "IGRP"
 addconfig "!"
 addconfig " ! IP routing protocol to
 35 use"
 addconfig "!"
 addconfig "router " \$routeprot
 addconfig "!"
 40 endif
 frame
 radio configipx "Do you want to configure IPX on
 this router?" "Yes" "No"
 45 if \$configipx = "Yes" then
 addconfig "!"
 addconfig " ! Enable IPX routing"
 addconfig "!"

50

55

```

      addconfig "ipx routing"
5       addconfig " !"
      frame
      radio yesno "Do you want password
protect configuration mode?"
"Yes" "No"
10      if $yesno = "Yes" then
                  askpass enablepassword
"Enter password for
configuration mode" minlen 5 maxlen 20
                  addconfig " !"
                  addconfig "enable
15      password " $password
                  addconfig " !"
      endif

20      endif
      frame
      addconfig " !"
      addconfig "no ip domain-lookup"
      addconfig " !"

25      ;ETHERNET0
      frame
      assign portname "Ethernet0"
30      use 2514eth.use

;ETHERNET1
      frame
35      assign portname "Ethernet1"
      use 2514eth.use

;SERIAL0
      frame
40      assign portname "SERIAL0"
      use 2514wan.use

;SERIAL1
45      frame
      assign portname "SERIAL1"
      use 2514wan.use

```

50

55

```

;BITMAP
bitmap      2514.bmp
5
locate      "ETHERNET0"      56   69   87   79
locate      "ETHERNET1"      110  69   141  79
locate      "SERIAL0"        250   64   302   82
locate      "SERIAL1"        326   64   377   82
10
:BITMAP_MENU
;Ethernet
15
menu "Something"
    menuitem "Pick me"
        define string 80
        askstring string "Enter something"
20
        addconfig "you entered " $string
menuend
;Serial0
25
menu "No items available yet"
;PROMPTS
>Password;
"-More-"
30

```

File: 2514vars.use

```

# variables to use with the Cisco 2514 config scripts
(2514.*)
35
define configip          3
define configipx         3
define routeprot         4
define password          30
40
define enablepassword    30
define ipaddress         15
define ipmask            15
define ipxaddress        20
define ipxencap          15
45
define lpsz              80
define portname          10
define yesno              3
define frconnector       10
50

```

55

```

define frdici          3
define frcir           4
5   define freir          4
    define frportspeed    4
    define pppmtu          5
    define pppauth         4
    define pppcompress     10
10  define ppplapb        3
    define ppptacacs       3
    define pppconnector    5
    define routername      30

15  File: 2514eth.use

        assign lpsz "Do you want to configure " $portname
        "?"
20  radio yesno $lpsz "Yes" "No"
    if $yesno = "Yes" then

        addconfig " !" $portname "configuration
commands"
25  addconfig " !"
        addconfig "interface" $portname
        addconfig " !"

        if $configip = "Yes" then
30
            frame
            getip ipaddress ipmask
            askip ipaddress ipmask "Enter IP network
that interface is plugged
35  into"

            addconfig " !"
            addconfig " ! IP related commands"
            addconfig " !"
40  $ipmask
            addconfig "ip address" $ipaddress " "
            addconfig " !"
            assignip $ipaddress $ipmask

45  endif

        if $configipx = "Yes" then

```

50

55

```

frame
getipx ipxaddress
askstring ipxaddress "Enter IPX network
5      number for this interface"
hex maxlen 8
frame
radio ipxencap "What type of IPX
10     ethernet encapsulation should be
used?" "ARPA" "Novell-Ether" "SAP" "SNAP"
addconfig " !"
addconfig " ! IPX related commands"
addconfig " !"
15     addconfig "ipx network" $ipxaddress
addconfig "ipx encap" $ipxencap
addconfig " !"
assignipx $ipxaddress

20     endif
endif

File: 2514wan.use
assign ipsz "Do you want to configure " $portname
25     "?"
radio yesno $ipsz "Yes" "No"

if $yesno = "Yes" then

30     addconfig " !"
addconfig " ! " $portname " configuration
commands"
addconfig "interface" $portname
addconfig " !"
35     if $configip = "Yes" then

frame
assign ipsz "Enter IP address for " $portname
40     askip ipaddress ipmask $ipsz
addconfig " !"
addconfig " ! IP related commands"
addconfig " !"
45     addconfig "ip address" $ipaddress " " $ipmask
endif

if $configipx = "Yes" then
frame
50

```

```

      assign lpsz "Enter IPX network number for "
5      $portname
      askstring ipxaddress $lpsz hex maxlen 8
      addconfig " !"
      addconfig " ! IPX related commands"
      addconfig " !"
      addconfig "novell address " $ipxaddress
      addconfig " !"
10     endif

      if $connected = "Frame Relay" then
15
      frame
      assign lpsz "Would you like to configure Frame
      Relay for "
      $portname "?"
20      assign yesno "Yes"
      radio yesno $lpsz "Yes" "No"
      if $yesno = "Yes" then

          addconfig " !"
25      radio yesno $lpsz "Yes" "No"
          if $yesno = "Yes" then

              addconfig " !"
              addconfig " ! Set Encapsulation to
30      Frame Relay"
              addconfig "encapsulation frame-relay"

              # radio frconnector "What connector
              type are you using?" "RS-232" "V.35"
35      askstring frdlci "What is your local
              DLCI" MIN 16 MAX 996
              # set DLCI command
              assign lpsz "What is " $portname
              "Physical Port Line Speed (Kbps)"
40      askstring frportspeed $lpsz MIN 1.2
              MAX 2048
              # set port speed command
              assign lpsz "What is the Committed
              Information Rate (CIR)
45      for " $portname "?"
              askstring frcir $lpsz MIN 1.2 MAX
              2048
              # set CIR command

```

50

55

```

      assign lpsz "What is the Excess
Information Rate (EIR) for *
$portname "?"  

5           askstring freir $lpsz MIN 1.2 MAX
2048
           # formula goes here
           # set EIR command
10          radio yesno "Do you want to use
compression?" "Yes" "No"
           # if goes here
           # set compression command
#OTHER PARAMETERS to set (some under advanced button)
15          #frportspeed
#frcir
#frier
#frremname
#frconnrtr
20          #frcompress
#frnettype
#frmxfmaxframe
#frcongmonper
#frmeasint
25          #frlit
#frpvt
#frfsef
#fret
#frcet
30          #frclocking
#fremulate
#fremulate
#frlinestate
#map
35          display "<more frame relay questions
would normally follow>"  

           endif .
           else
           if $connected = "PPP" then
40
               frame
               assign lpsz "Would you like to configure
PPP for " $portname "?"
               assign yesno "Yes"
45           radio yesno $lpsz "Yes" "No"
           if $yesno = "Yes" then
               # Set defaults

```

50

55

```

      assign ppmtu "1500"
      assign pppauth "CHAP"
      assign pppcompress "Stacker"
      assign ppplapb "No"
      assign pptacacs "No"

      addconfig " !"
      addconfig " ! Set Encapsulation to
10    PPP"
      addconfig "encapsulation ppp"

      #           radio pppconnector "What connector type
15    are you using?" "RS-232"
      "V.35"

      frame
      radio pppauth "What authentication
20    protocol are you using?"
      "PAP" "CHAP" "Off"
      if $pppauth <> "Off" then
          addconfig " !"
          addconfig " ! PPP Authorization

25    related
    commands"
      addconfig " !"
      addconfig " no     p p p
authentication"
      endif
      endif

      frame
      radio pppcompress "What compression method
35    are you using?"
      "Predictor" "Stacker" "Off"
      if $pppcompress <> "Off" then
          addconfig " !"
          addconfig " ! PPP Compression related

40    commands"
          addconfig " !"
          addconfig "ppp     compress      "
$pppcompress
      else
45    if $pppcompress = "Off" then
          addconfig " !"
          addconfig " ! PPP Compression
related commands"

```

50

55

```

      addconfig " !"
      addconfig "no ppp compression"
5      endif
      endif

      frame
      radio ppplapb "Use LAPB with PPP for
10     reliable link?" "Yes"
      "No"
      if $ppplapb = "Yes" then
          addconfig " !"
          addconfig " ! PPP LAPB with PPP for
15     reliable link related commands"
          addconfig " !"
          addconfig "ppp reliable-link"
      else
          addconfig " !"
          addconfig " ! PPP LAPB with PPP for
20     reliable link
          related commands"
          addconfig " !"
          addconfig "no ppp reliable-link"
25      endif
      frame

      radio ppptacacs "Use TACACS to verify PPP
authentication?"
30     "Yes" "No"
      if $ppptacacs = "Yes" then
          addconfig " !
          addconfig " ! Use TACACS to verify
      PPP authentication
35     addconfig "ppp use-tacacs"
      else
          addconfig " !
          addconfig " ! Use TACACS to verify
      PPP authentication"
40     addconfig " !
          addconfig "no ppp use-tacacs"
      endif

      frame
45     assign lpsz "What is the Maximum
Transmission Unit for "
      $portname "?"

```

50

55

```

4096           askstring pppmtu $lpsz MIN 64 MAX
5             addconfig " !
addconfig   "   !      Set     Maximum
Transmission Unit"
10            addconfig "mtu " $pppmtu
addconfig "ip mtu " $pppmtu
endif
else
15           display $portname " is connected to a "
$connected " network"
display "appropriate guided configuration
commands would appear here"
endif
endif
20           ©1995 Compaq Computer Corporation

```

25 **Claims**

1. A computer program product (10) for a computer system (2) having a processor subsystem (4) and a memory subsystem (6) coupled by a system bus (8) for bi-directional exchanges therebetween, for configuring a network device (26) remotely coupled thereto, the computer program product comprising:

30 at least one configuration script (12) stored in said memory subsystem (6), said configuration script (12) containing a series of executable instructions for constructing a configuration file;
a first software module (14) for constructing, when executed by said processor subsystem (4), a configuration file (20,22) suitable for upload to a network device of a first specified type said first software module constructing
35 said configuration file (20,22) by executing said series of instructions contained in said configuration script (12), said configuration script (12) further comprising a series of configuration commands which generate requests for information, a set of connection rules for connecting said first specified type of network device to at least one other specified type of network device, at least an identifier (34b) for each connection interface of said first specified type of network device and a list of network device types that can be connected to the
40 connection interface associated therewith, said list being provided for each of said identifiers (34b); **characterised**
In that the at least one configuration script (12) constructs a bootptab file (32) for a first specified type of network device which is suitable for identifying said network device (26) wherein the bootptab file is used to assist with remote configuration of the network device;
45 **In that** said first software module (14) constructs said bootptab file (32) by executing said series of instructions contained in said configuration script (12);
by a second software module (18) for processing, when executed by said processor subsystem (4), a configuration request issued by said network device (26) by identifying said network device using said constructed bootptab file (32) and configuring said network device by uploading said constructed configuration file (20,22)
50 thereto; and
In that said series of configuration commands is included in a first section (40) of said configuration script (12) and in that said set of connection rules, said at least one identifier (34b) and said list of network device types are included in a second section (34) of said configuration script.
- 55 2. A computer program product (10) according to claim 1, wherein information received by said software module (14,18) in response to said requests for information is used to construct said configuration file (20,22) and said bootptab file (32).

3. A computer program product (10) according to claim 1, wherein said second section (34) of said configuration script (12) further comprises:

5 a first portion (34b) which uniquely identifies said network device; and
a second portion which identifies devices installed in said network device.

- 10 4. A computer program product (10) according to claim 3, wherein said first section (40) of said configuration script (12) further comprises:

15 a first portion (40b-1 to 40b-N) corresponding to each of said at least one other specified type of network device (26) specified in said connection rules contained in said second section (34) of said configuration script (12);
said first portion containing a subset of said series of configuration commands which are executed only if said network device (26) for which said configuration file (20,22) is being constructed is connected to a network device of said other specified type of network device.

- 20 5. A method for configuring a remotely located network device (26), the method comprising the steps of:

25 providing a configuration script containing a series of executable instructions for constructing a configuration file (20,22) for a first specified type of network device (26);
constructing a configuration file (20,22) by executing said series of instructions contained in said configuration script (12) wherein the configuration script (12) includes a series of configuration commands, a set of connection rules for connecting said first specified type of network device to at least one other specified type of network device (26), at least an identifier (34b) for each connection interface of said first specified type of network device and a list of network device types that can be connected to the connection interface associated therewith, said list being provided for each of said identifiers (34b); **characterised by** the further steps of
30 constructing a bootptab file (32) for said first specified type of network device by executing said series of instructions contained in said configuration script (12);
detecting a request for configuration issued by a network device (26);
determining if said configuration file (20,22) corresponds to said network device (26) issuing said request for configuration by using said constructed bootptab file (32);
if said configuration file (20,22) corresponds to said network device, issuing a reply which identifies said configuration file to said network device (26); and
35 issuing said configuration file (20,22) to said network device (26) in response to a request for configuration file which identifies said configuration file;
wherein said series of configuration commands is included in a first section (40) of said configuration script (12) and wherein said set of connection rules, said at least one identifier (34b) and said list of network device types are included in a second section (34) of said configuration script.

- 40 6. A method according to claim 5, further comprising the steps of:

45 generating requests for information by executing said series of configuration commands contained in said first section (40) of said configuration script (12); and
constructing said configuration file (20,22) using information received in response to said requests for information.

- 50 7. A method according to claim 6, further comprising the step of:

55 constructing a bootptab (32) file which contains a unique identifier and said configuration file for said network device (26).

- 60 8. A method according to claim 7, wherein the step of determining if said configuration file (20,22) corresponds to said network device (26) issuing said request for configuration further comprises the steps of:

65 determining if said network device (26) issuing said request for configuration has an identification code which matches an identification code contained in said bootptab file (32); and
determining if devices installed in said network device (26) issuing said request for configuration matches installed devices identified in said bootptab file (32).

9. A method according to claim 5, wherein the step of providing a configuration script (12) containing a series of executable instructions further comprises the step of:

5 providing a configuration script (12) which includes, within said second section (34), a first portion corresponding to each of said at least one other specified type of network device (26) specified in said connection rules contained in said second section of said configuration script;
each said first portion containing a subset of said series of configuration commands.

10. A method according to claim 9, further comprising the step of:

10 executing said subset of said series of configuration commands contained in each said first portion only if said network device (26) for which said configuration file (20,22) is being constructed is connected to a network device of said other specified type of network device.

15

Patentansprüche

1. Computerprogrammprodukt (10) für ein Computersystem (2) mit einem Prozessor-Teilsystem (4) und einem Speicher-Teilsystem (6), die durch einen Systembus (8) zum bidirektionalen Austausch zwischen ihnen verbunden sind, um eine Netzwerk-Vorrichtung (26) zu konfigurieren, die in Entfernung damit verbunden ist, wobei das Computerprogrammprodukt umfasst:

20 wenigstens ein Konfigurations-Skript (12), das in dem Speicher-Teilsystem (6) gespeichert ist, wobei das Konfigurations-Skript (12) eine Reihe ausführbarer Befehle zum Aufbauen einer Konfigurations-Datei enthält;

25 ein erstes Software-Modul (14), mit dem, wenn es von dem Prozessor-Teilsystem (4) ausgeführt wird, eine Konfigurations-Datei (20, 22) aufgebaut wird, die sich zum Hochladen zu einer Netzwerk-Vorrichtung eines ersten vorgegebenen Typs eignet, wobei das erste Software-Modul die Konfigurations-Datei (20, 22) aufbaut, indem es die Reihe von Befehlen ausführt, die in dem Konfigurations-Skript (12) enthalten sind, wobei das Konfigurations-Skript (12) des Weiteren eine Reihe von Konfigurations-Kommandos, die Anforderungen nach Informationen erzeugen, eine Gruppe von Verbindungs-Regeln zum Verbinden des ersten vorgegebenen Typs Netzwerk-Vorrichtung mit wenigstens einem anderen vorgegebenen Typ Netzwerk-Vorrichtung, wenigstens eine Kennung (34b) für jede Verbindungs-Schnittstelle des ersten vorgegebenen Typs Netzwerk-Vorrichtung und eine Liste von Netzwerk-Vorrichtungstypen umfasst, die mit der dazugehörigen Verbindungs-Schnittstelle verbunden werden können, wobei die Liste für jede der Kennungen (34b) vorhanden ist, **gekennzeichnet**,

30 dadurch, dass wenigstens ein Konfigurations-Skript (12) eine Bootptab-Datei (32) für einen ersten vorgegebenen Typ Netzwerk-Vorrichtung aufbaut, die sich zum Identifizieren der Netzwerk-Vorrichtung (26) eignet, wobei die Bootptab-Datei eingesetzt wird, um bei der Fern-Konfiguration der Netzwerk-Vorrichtung unterstützend zu wirken;

35 dadurch, dass das erste Software-Modul (14) die Bootptab-Datei (32) aufbaut, indem es die Reihe von Befehlen ausführt, die in dem Konfigurations-Skript (12) enthalten sind;

40 durch ein zweites Software-Modul (18), mit dem, wenn es von dem Prozessor-Teilsystem (4) ausgeführt wird, eine Konfigurations-Anforderung verarbeitet wird, die von der Netzwerk-Vorrichtung (26) ausgegeben wird, indem die Netzwerk-Vorrichtung unter Verwendung der aufgebauten Bootptab-Datei (32) identifiziert wird und die Netzwerk-Vorrichtung konfiguriert wird, indem die aufgebaute Konfigurations-Datei (20, 22) zu ihr hochgeladen wird; und

45 dadurch, dass die Reihe von Konfigurations-Kommandos in einem ersten Abschnitt (40) des Konfigurations-Skripts (12) eingeschlossen ist, und dadurch, dass die Gruppe von Verbindungs-Regeln, die wenigstens eine Kennung (34b) und die Liste von Netzwerk-Vorrichtungstypen in einem zweiten Abschnitt (34) des Konfigurations-Skripts eingeschlossen sind.

50

- 55 2. Computerprogrammprodukt (10) nach Anspruch 1, wobei Informationen, die von dem Software-Modul (14,18) in Reaktion auf die Anforderungen nach Informationen empfangen werden, genutzt werden, um die Konfigurations-Datei (20, 22) und die Bootptab-Datei (32) aufzubauen.

3. Computerprogrammerzeugnis (10) nach Anspruch 1, wobei der zweite Abschnitt (34) des Konfigurations-Skripts (12) des Weiteren umfasst:

5 einen ersten Teil (34b), der die Netzwerk-Vorrichtung eindeutig identifiziert; und

10 einen zweiten Teil, der in der Netzwerk-Vorrichtung installierte Vorrichtungen identifiziert.

4. Computerprogrammerzeugnis (10) nach Anspruch 3, wobei der erste Abschnitt (40) des Konfigurations-Skripts (12) des Weiteren umfasst:

15 einen ersten Teil (40b-1 bis 40b-N), der jedem des wenigstens einen anderen vorgegebenen Typs Netzwerk-Vorrichtung (26) entspricht, der in den Verbindungs-Regeln vorgegeben ist, die in dem zweiten Abschnitt (34) des Konfigurations-Skripts (12) enthalten sind;

20 wobei der erste Teil eine Untergruppe der Reihe von Konfigurations-Kommandos enthält, die nur dann ausgeführt werden, wenn die Netzwerk-Vorrichtung (26), für die die Konfigurations-Datei (20, 22) aufgebaut wird, mit einer Netzwerk-Vorrichtung des anderen vorgegebenen Typs Netzwerk-Vorrichtung verbunden ist.

- 25 5. Verfahren zum Konfigurieren einer entfernt angeordneten Netzwerk-Vorrichtung (26), wobei das Verfahren die folgenden Schritte umfasst:

Bereitstellen eines Konfigurations-Skripts, das eine Reihe ausführbarer Befehle zum Aufbauen einer Konfigurations-Datei (20, 22) für einen ersten vorgegebenen Typ Netzwerk-Vorrichtung (26) enthält;

30 25 Aufbauen einer Konfigurations-Datei (20, 22) durch Ausführen der Reihe von Befehlen, die in dem Konfigurations-Skript (12) enthalten sind, wobei das Konfigurations-Skript (12) eine Reihe von Konfigurations-Kommandos, eine Gruppe von Verbindungs-Regeln zum Verbinden des ersten vorgegebenen Typs Netzwerk-Vorrichtung mit wenigstens einem weiteren vorgegebenen Typ Netzwerk-Vorrichtung (26), wenigstens eine Kennung (34b) für jede Verbindungs-Schnittstelle des ersten vorgegebenen Typs Netzwerk-Vorrichtung und eine Liste von Netzwerk-Vorrichtungstypen einschließt, die mit der dazugehörigen Verbindungs-Schnittstelle verbunden werden können, wobei die Liste für jede der Kennungen (34b) bereitgestellt wird;

35 gekennzeichnet durch die folgenden weiteren Schritte:

Aufbauen einer Bootptab-Datei (32) für den ersten vorgegebenen Typ Netzwerk-Vorrichtung durch Ausführen der Reihe von Befehlen, die in dem Konfigurations-Skript (12) enthalten sind;

Erfassen einer Anforderung zum Konfigurieren, die von der Netzwerk-Vorrichtung (26) ausgegeben wird;

40 Feststellen, ob die Konfigurations-Datei (20,22) der Netzwerk-Vorrichtung (26) entspricht, die die Anforderung zum Konfigurieren ausgibt, indem die aufgebaute Bootptab-Datei (32) genutzt wird;

Ausgeben einer Erwiderung, die die Konfigurations-Datei für die Netzwerk-Vorrichtung (26) identifiziert, wenn die Konfigurations-Datei (20, 22) der Netzwerk-Vorrichtung entspricht; und

45 Ausgeben der Konfigurations-Datei (20,22) an die Netzwerk-Vorrichtung (26) in Reaktion auf eine Anforderung nach der Konfigurations-Datei, die die Konfigurations-Datei identifiziert;

50 wobei die Reihe von Konfigurations-Kommandos in einem ersten Abschnitt (40) des Konfigurations-Skripts (12) enthalten ist, und wobei die Gruppe von Verbindungs-Regeln, die wenigstens eine Kennung (34b) und die Liste von Netzwerk-Vorrichtungstypen in einem zweiten Abschnitt (34) des Konfigurations-Skripts eingeschlossen sind.

6. Verfahren nach Anspruch 5, das des Weiteren die folgenden Schritte umfasst:

55 Erzeugen von Anforderungen nach Informationen durch Ausführen der Reihe von Konfigurations-Kommandos, die in dem ersten Abschnitt (40) des Konfigurations-Skripts (12) enthalten sind; und

Aufbauen der Konfigurations-Datei (20, 22) unter Verwendung von Informationen, die in Reaktion auf die An-

forderungen nach Informationen empfangen werden.

7. Verfahren nach Anspruch 6, das des Weiteren den folgenden Schritt umfasst:

5 Aufbauen einer Bootptab-Datei (32), die eine eindeutige Kennung und die Konfigurations-Datei für die Netzwerk-Vorrichtung (26) enthält.

8. Verfahren nach Anspruch 7, wobei der Schritt des Feststellens, ob die Konfigurations-Datei (20, 22) der Netzwerk-Vorrichtung (26) entspricht, die die Anforderung zum Konfigurieren ausgibt, des Weiteren die folgenden Schritte 10 umfasst:

Feststellen, ob die Netzwerk-Vorrichtung (26), die die Anforderung zum Konfigurieren ausgibt, einen Kennungscode aufweist, der einem Kennungscode entspricht, der in der Bootptab-Datei (32) enthalten ist; und

15 Feststellen, ob Vorrichtungen, die in der Netzwerk-Vorrichtung (26) installiert sind, die die Anforderung zum Konfigurieren ausgibt, installierten Vorrichtungen entsprechen, die in der Bootptab-Datei (32) identifiziert werden.

9. Verfahren nach Anspruch 5, wobei der Schritt des Bereitstellens eines Konfigurations-Skripts (12), das eine Reihe 20 ausführbarer Befehle enthält, des Weiteren den folgenden Schritt umfasst:

Bereitstellen eines Konfigurations-Skripts (12), das in dem zweiten Abschnitt (34) einen ersten Teil einschließt, der jedem des wenigstens einen anderen vorgegebenen Typs Netzwerk-Vorrichtung (26) entspricht, der in den Verbindungs-Regeln vorgegeben ist, die in dem zweiten Abschnitt des Konfigurations-Skripts enthalten 25 sind;

wobei jeder der ersten Abschnitte eine Untergruppe der Reihe von Konfigurations-Kommandos enthält.

10. Verfahren nach Anspruch 9, das des Weiteren den folgenden Schritt umfasst:

30 Ausführen der Untergruppe der Reihe von Konfigurations-Kommandos, die in jedem ersten Abschnitt enthalten ist, nur dann, wenn die Netzwerk-Vorrichtung (26), für die die Konfigurations-Datei (20, 22) aufgebaut wird, mit einer Netzwerk-Vorrichtung des anderen vorgegebenen Typs Netzwerk-Vorrichtung verbunden ist.

35

Revendications

1. Produit de programme informatique (10) pour un système informatique (2) comportant un sous-système de processeur (4) et un sous-système de mémoire (6) couplés par un bus système (8) pour des échanges bidirectionnels 40 entre ceux-ci, pour configurer un dispositif de réseau (26) couplé à distance avec ceux-ci, le produit de programme informatique comprenant :

- au moins un script de configuration (12) stocké dans ledit sous-système de mémoire (6), ledit script de configuration (12) contenant une série d'instructions exécutables pour construire un fichier de configuration ;
- un premier module logiciel (14) pour construire, quand il est exécuté par ledit sous-système de processeur (4), un fichier de configuration (20, 22) adapté pour le téléchargement sur un dispositif de réseau d'un premier type spécifié, ledit premier module logiciel construisant ledit fichier de configuration (20, 22) en exécutant ladite série d'instructions contenue dans ledit script de configuration (12), ledit script de configuration (12) comprenant en outre une série de commandes de configuration qui génèrent des requêtes d'information, un jeu de règles de connexion pour connecter ledit premier type spécifié de dispositif de réseau à au moins un autre type spécifié de dispositif de réseau, au moins un identificateur (34b) pour chaque interface de connexion dudit premier type spécifié de dispositif de réseau et une liste de types de dispositif de réseau qui peuvent être connectés à l'interface de connexion associée à ceux-ci, ladite liste étant prévue pour chacun desdits identificateurs (34b), **caractérisé**
- **en ce que** ledit au moins un script de configuration (12) construit un fichier bootptab (32) pour un premier type spécifié de dispositif de réseau qui est adapté pour identifier ledit dispositif de réseau (26), dans lequel le fichier bootptab est utilisé pour contribuer à la configuration à distance du dispositif de réseau ;
- **en ce que** ledit premier module logiciel (14) construit ledit fichier bootptab (32) en exécutant ladite série d'ins-

- tructions contenue dans ledit script de configuration (12) ;
- par un deuxième module logiciel (18) pour traiter, quand il est exécuté par ledit sous-système de processeur (4), une requête de configuration émise par ledit dispositif de réseau (26) en identifiant ledit dispositif de réseau à l'aide dudit fichier bootptab (32) construit et en configurant ledit dispositif de réseau en téléchargeant ledit fichier de configuration (20, 22) construit sur celui-ci ; et
 - **en ce que ladite série de commandes de configuration est comprise dans une première section (40) dudit script de configuration (12) et en ce que ledit jeu de règles de connexion, ledit au moins un identificateur (34b) et ladite liste de types de dispositif de réseau sont compris dans une deuxième section (34) dudit script de configuration.**
- 10 2. Produit de programme informatique (10) selon la revendication 1, dans lequel les informations reçues par ledit module logiciel (14, 18) en réponse auxdites requêtes d'information sont utilisées pour construire ledit fichier de configuration (20, 22) et ledit fichier bootptab (32).
- 15 3. Produit de programme informatique (10) selon la revendication 1, dans lequel ladite deuxième section (34) dudit script de configuration (12) comprend en outre :
- une première partie (34b) qui identifie de façon unique ledit dispositif de réseau ; et
 - une deuxième partie qui identifie des dispositifs installés dans ledit dispositif de réseau.
- 20 4. Produit de programme informatique (10) selon la revendication 3, dans lequel ladite première section (40) dudit script de configuration (12) comprend en outre :
- une première partie (40b 1 à 40b N) correspondant à chacun dudit au moins un autre type spécifié de dispositif de réseau (26) spécifié dans lesdites règles de connexion contenues dans ladite deuxième section (34) dudit script de configuration (12) ;
 - ladite première partie contenant un sous-ensemble de ladite série de commandes de configuration qui sont exécutées uniquement si ledit dispositif de réseau (26) pour lequel ledit fichier de configuration (20, 22) est construit est connecté à un dispositif de réseau dudit autre type spécifié de dispositif de réseau.
- 25 5. Procédé de configuration d'un dispositif de réseau situé à distance (26), le procédé comprenant les étapes consistant à :
- prévoir un script de configuration contenant une série d'instructions exécutables pour construire un fichier de configuration (20, 22) pour un premier type spécifié de dispositif de réseau (26) ;
 - construire un fichier de configuration (20, 22) en exécutant ladite série d'instructions contenue dans ledit script de configuration (12), dans lequel le script de configuration (12) comprend une série de commandes de configuration, un jeu de règles de connexion pour connecter ledit premier type spécifié de dispositif de réseau à au moins un autre type spécifié de dispositif de réseau (26), au moins un identificateur (34b) pour chaque interface de connexion dudit premier type spécifié de dispositif de réseau et une liste de types de dispositif de réseau qui peuvent être connectés à l'interface de connexion associée à ceux-ci, ladite liste étant prévue pour chacun desdits identificateurs (34b), **caractérisé par les étapes supplémentaires consistant à :**
- 30 45 - construire un fichier bootptab (32) pour ledit premier type spécifié de dispositif de réseau en exécutant ladite série d'instructions contenue dans ledit script de configuration (12) ;
- détecter une requête de configuration émise par un dispositif de réseau (26) ;
 - déterminer si ledit fichier de configuration (20, 22) correspond audit dispositif de réseau (26) émettant ladite requête de configuration à l'aide dudit fichier bootptab (32) construit ;
 - si ledit fichier de configuration (20, 22) correspond audit dispositif de réseau, émettre une réponse qui identifie ledit fichier de configuration auprès dudit dispositif de réseau (26) ; et
 - émettre ledit fichier de configuration (20, 22) à destination dudit dispositif de réseau (26) en réponse à une requête de fichier de configuration qui identifie ledit fichier de configuration ;
 - dans lequel ladite série de commandes de configuration est comprise dans une première section (40) dudit script de configuration (12), et dans lequel ledit jeu de règles de connexion, ledit au moins un identificateur (34b) et ladite liste de types de dispositif de réseau sont compris dans une deuxième section (34) dudit script de configuration.
- 50 55 6. Procédé selon la revendication 5, comprenant en outre les étapes consistant à :

- générer des requêtes d'information en exécutant ladite série de commandes de configuration contenue dans ladite première section (40) dudit script de configuration (12) ; et
- construire ledit fichier de configuration (20, 22) à l'aide d'informations reçues en réponse auxdites requêtes d'information.

5

7. Procédé selon la revendication 6, comprenant en outre les étapes consistant à :

- construire un fichier bootptab (32) qui contient un identificateur unique et ledit fichier de configuration pour ledit dispositif de réseau (26).

10

8. Procédé selon la revendication 7, dans lequel l'étape consistant à déterminer si ledit fichier de configuration (20, 22) correspond audit dispositif de réseau (26) émettant ladite requête de configuration comprend en outre les étapes consistant à :

15

- déterminer si ledit dispositif de réseau (26) émettant ladite requête de configuration a un code d'identification qui correspond à un code d'identification contenu dans ledit fichier bootptab (32) ; et
- déterminer si des dispositifs installés dans ledit dispositif de réseau (26) émettant ladite requête de configuration correspondent à des dispositifs installés identifiés dans ledit fichier bootptab (32).

20

9. Procédé selon la revendication 5, dans lequel l'étape consistant à prévoir un script de configuration (12) contenant une série d'instructions exécutables comprend en outre l'étape consistant à :

25

prévoir un script de configuration (12) qui comprend, à l'intérieur de ladite deuxième section (34), une première partie correspondant à chacun dudit au moins un autre type spécifié de dispositif de réseau (26) spécifié dans lesdites règles de connexion contenues dans ladite deuxième section dudit script de configuration ;
- chaque dite première partie contenant un sous-ensemble de ladite série de commandes de configuration.

10. Procédé selon la revendication 9, comprenant en outre l'étape consistant à :

30

- exécuter ledit sous-ensemble de ladite série de commandes de configuration contenue dans chaque dite première partie seulement si ledit dispositif de réseau (26) pour lequel ledit fichier de configuration (20, 22) est construit est connecté à un dispositif de réseau dudit autre type spécifié de dispositif de réseau.

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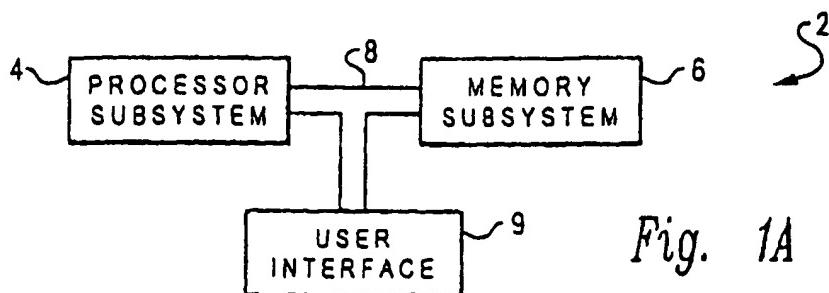


Fig. 1A

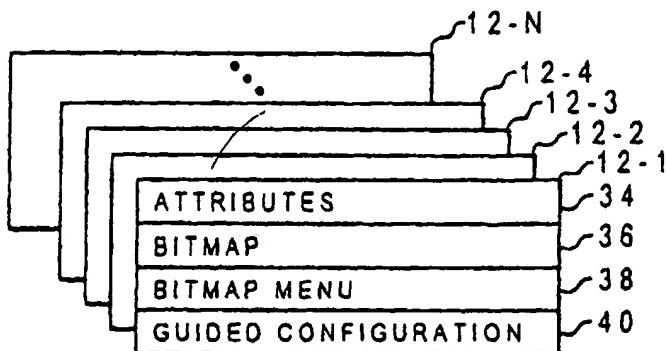


Fig. 2A

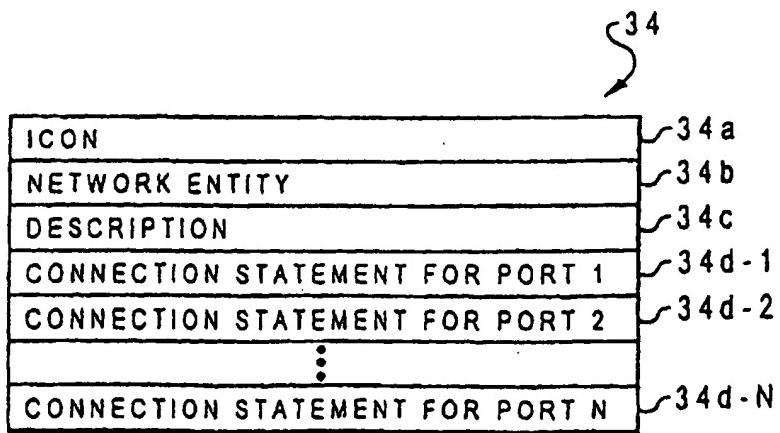


Fig. 2B

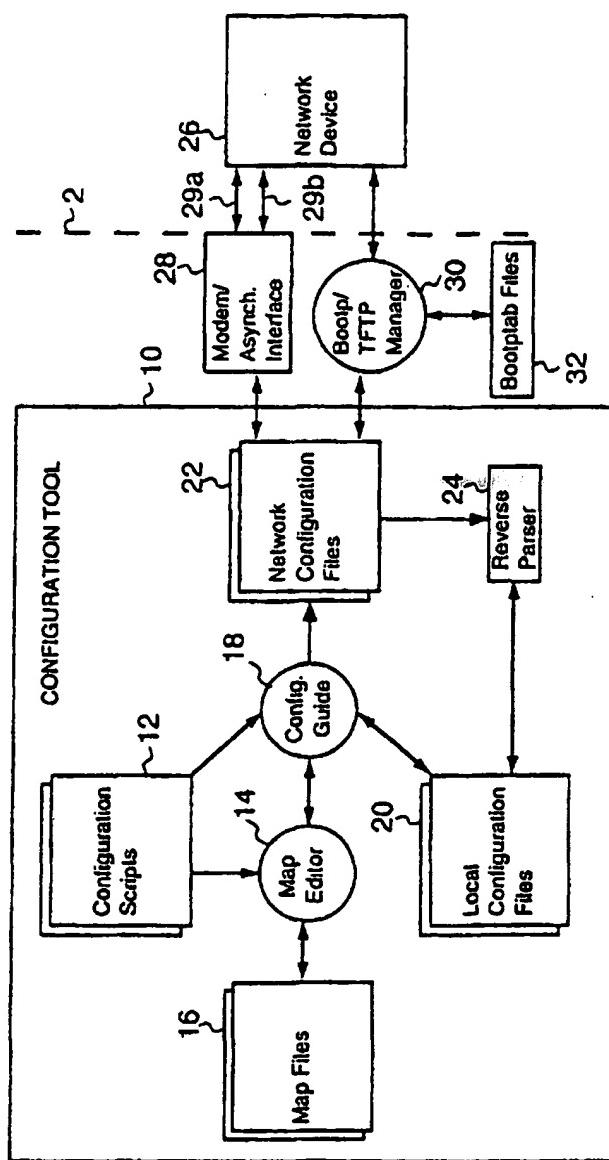


Fig. 1B

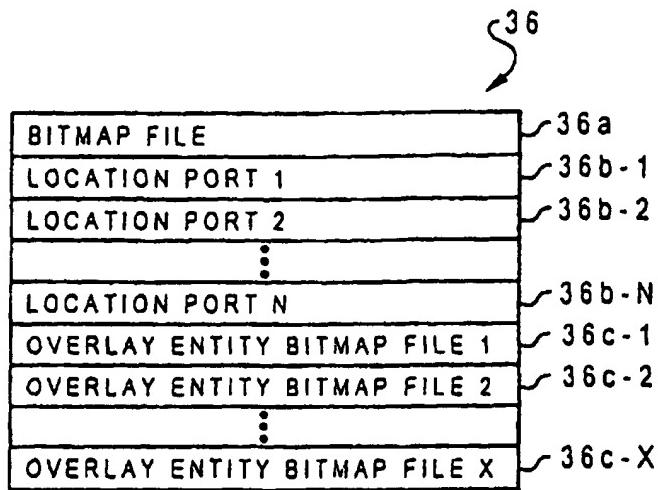


Fig. 2C

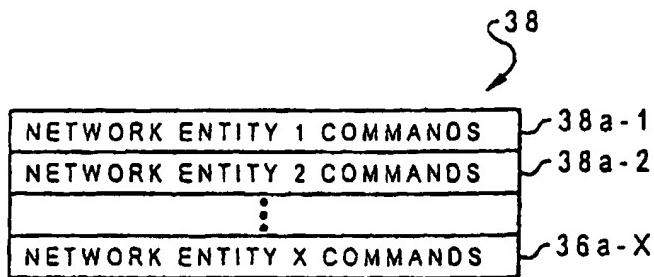


Fig. 2D

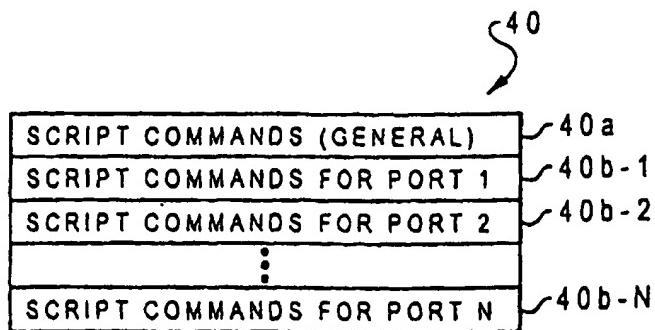


Fig. 2E

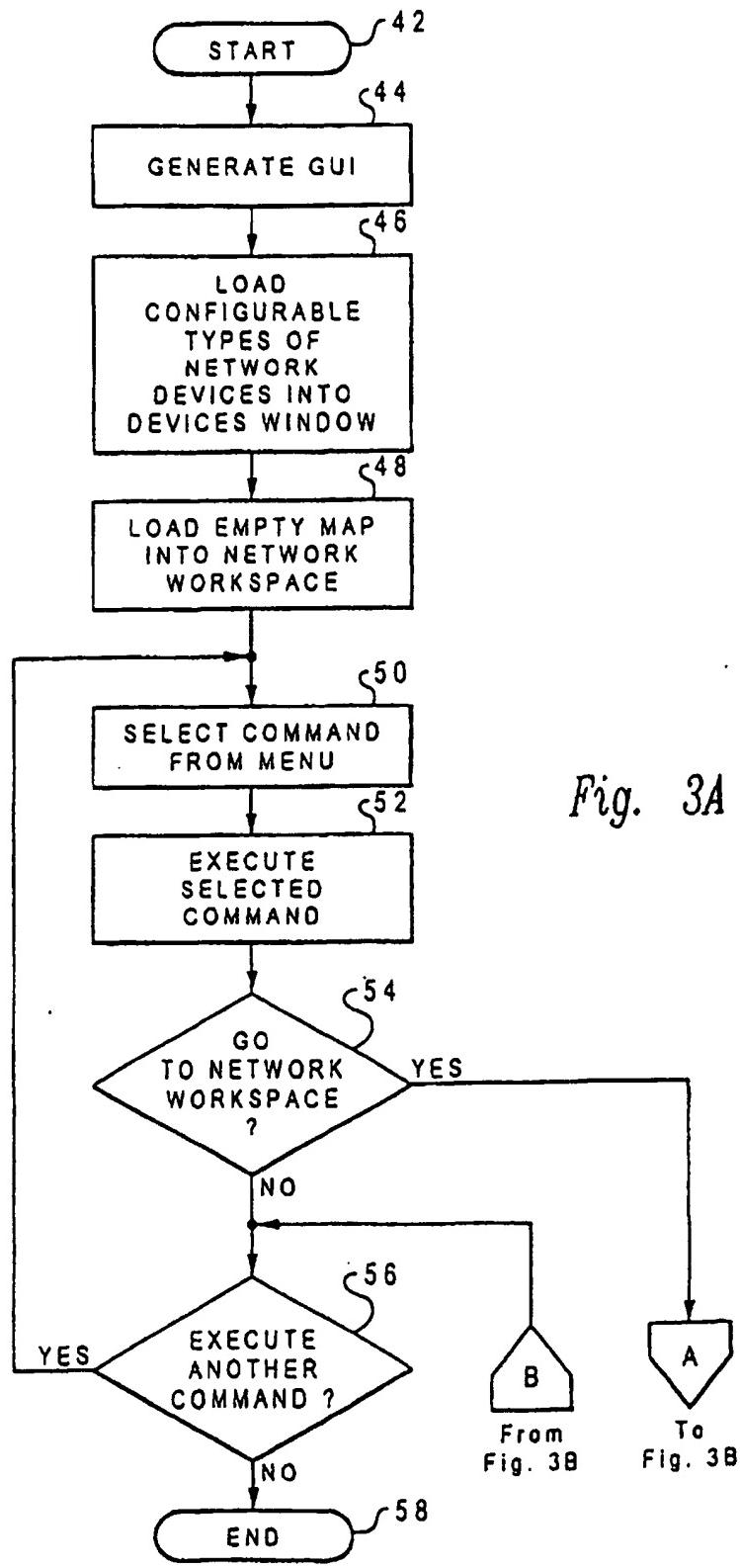
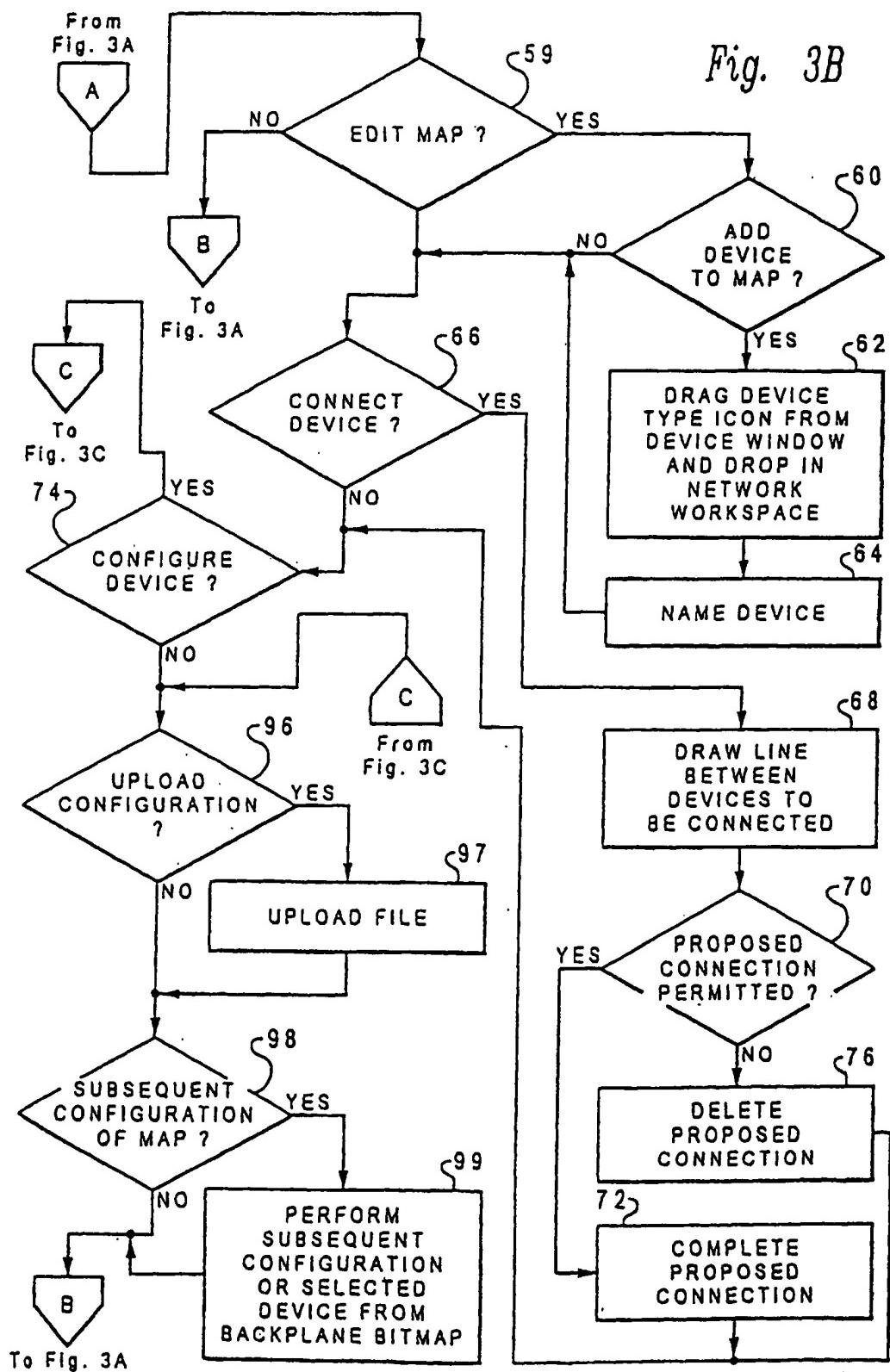


Fig. 3A

From Fig. 3B To Fig. 3B



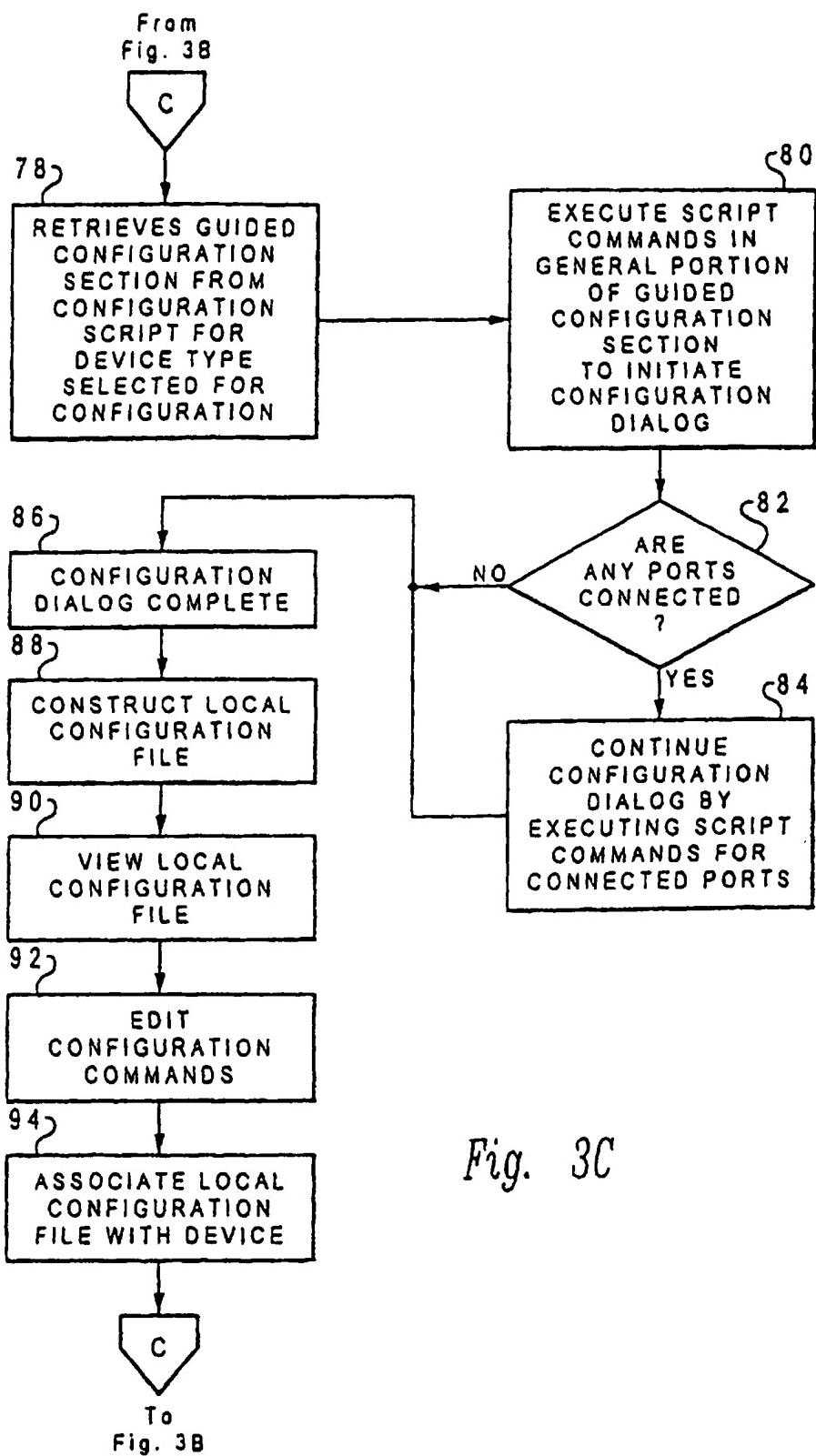


Fig. 3C

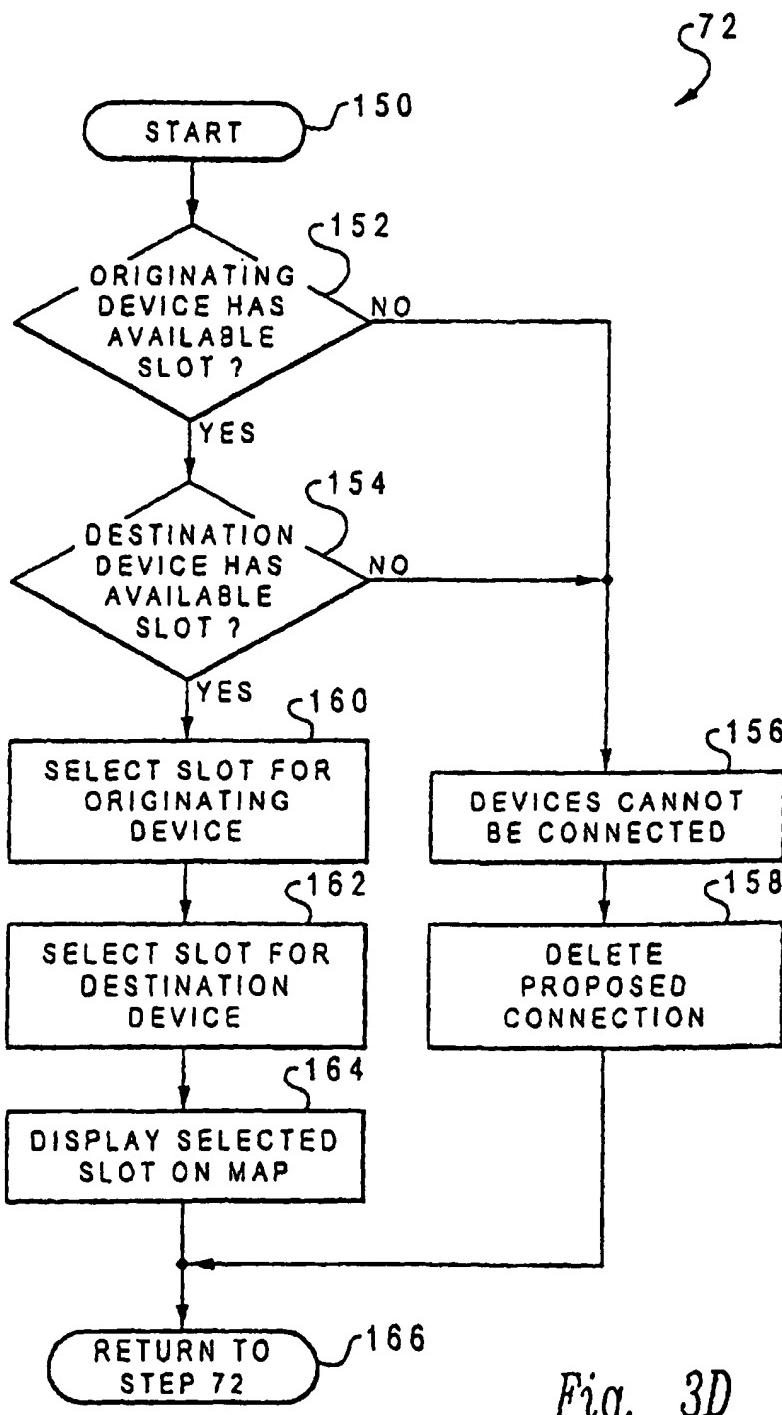


Fig. 3D

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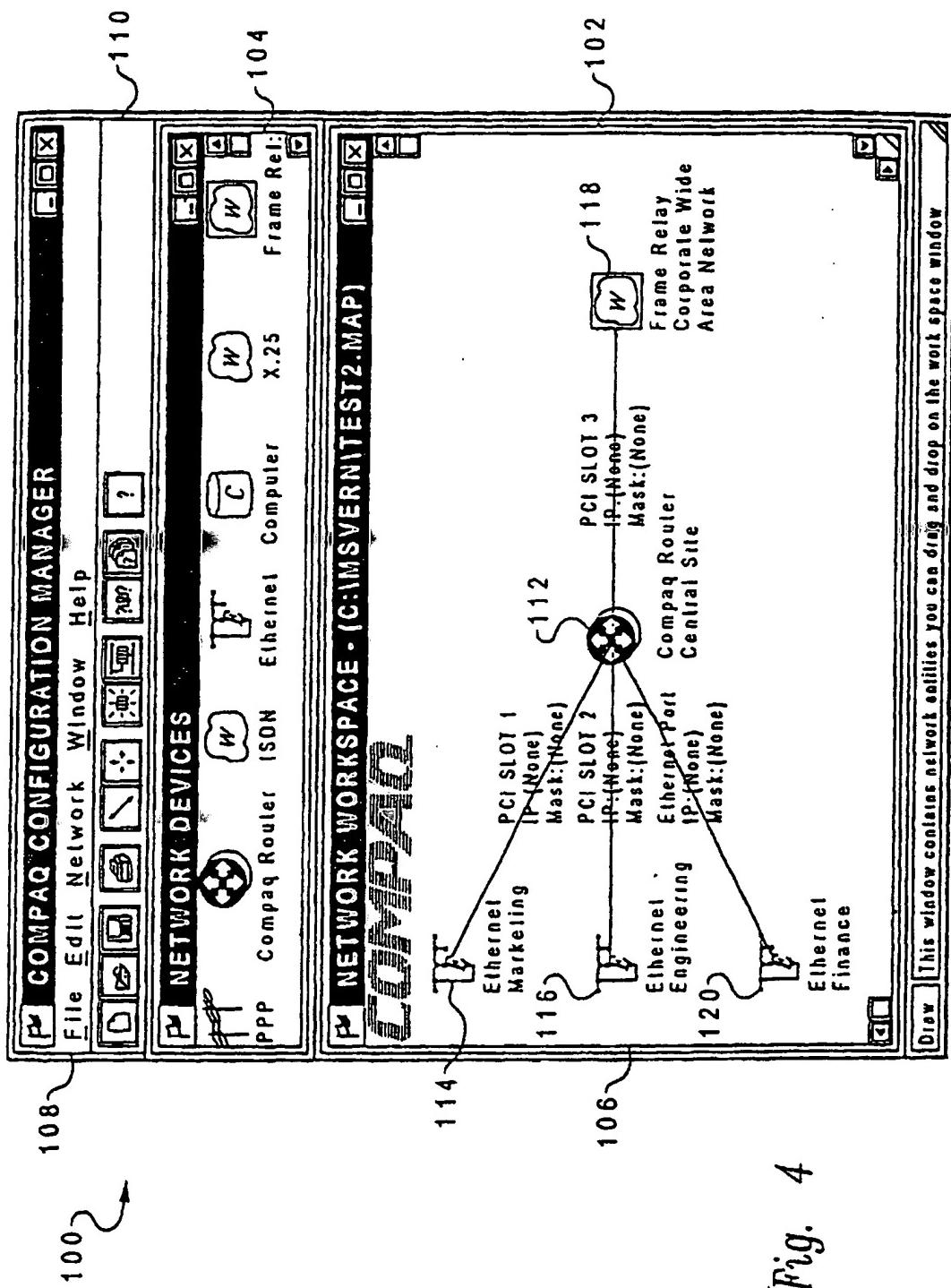


Fig. 4

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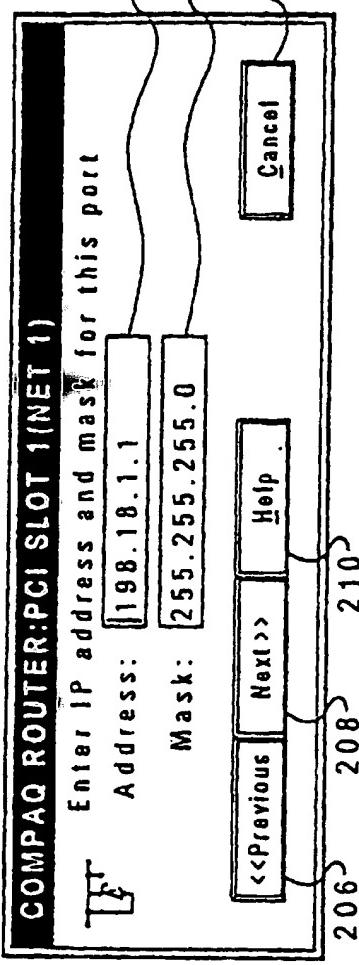


Fig. 5

220

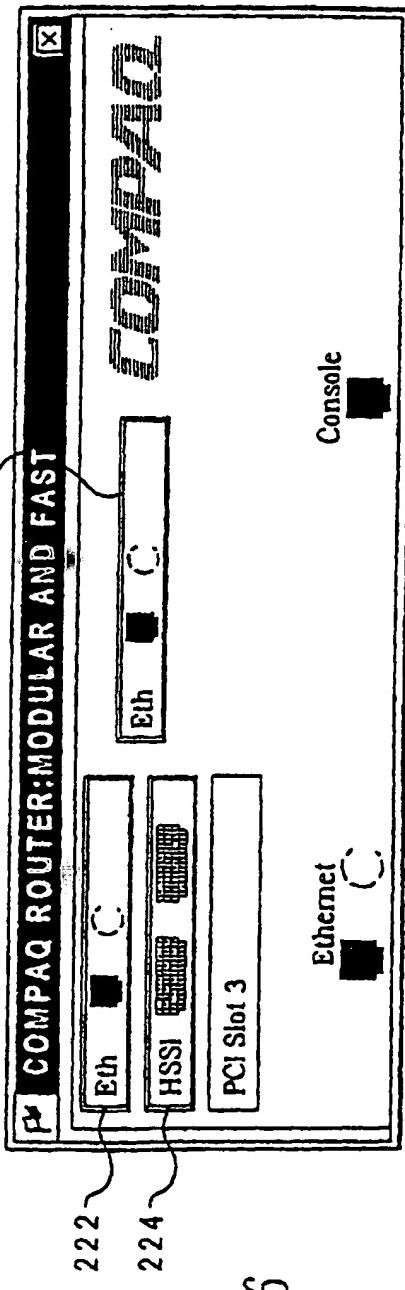


Fig. 6

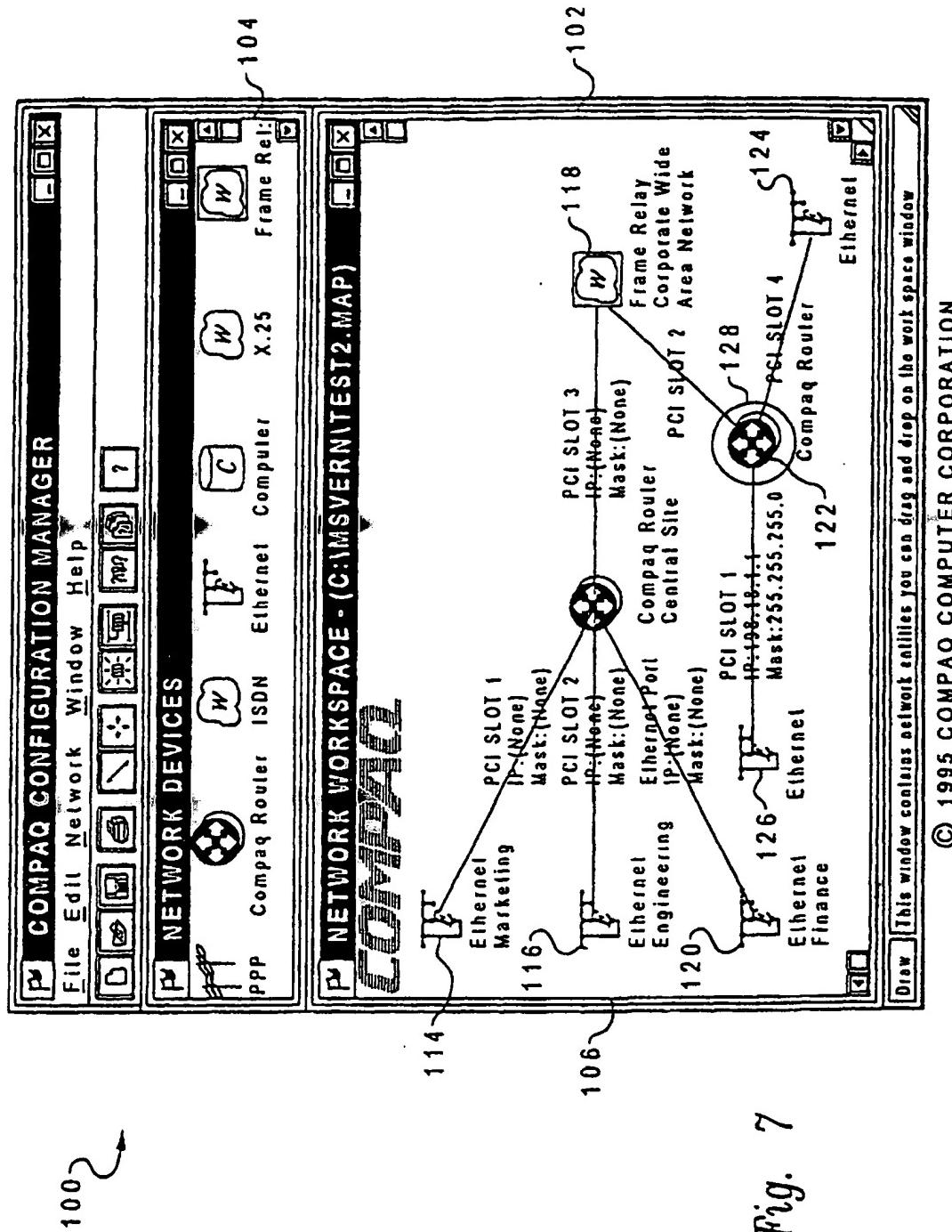


Fig. 7

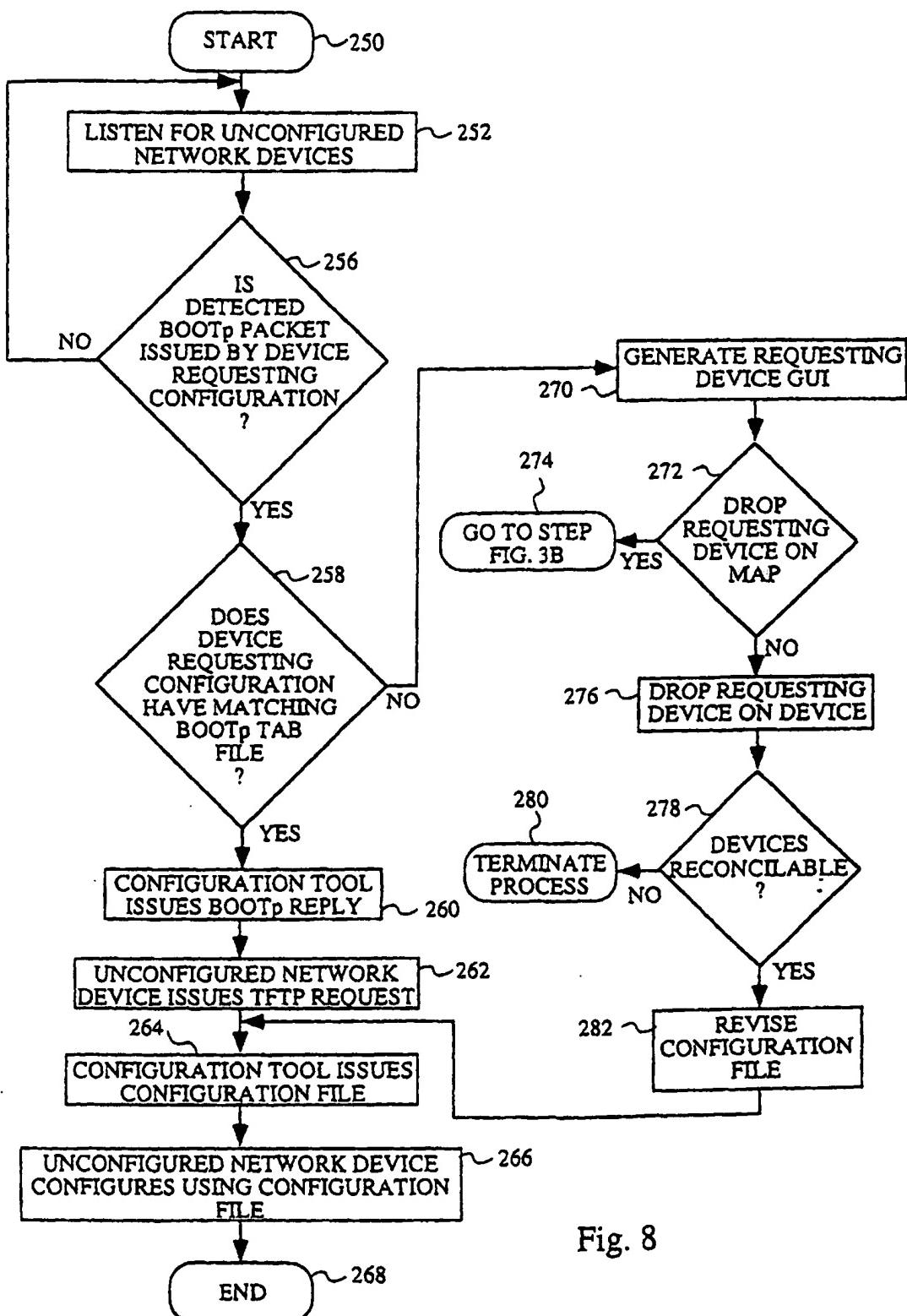


Fig. 8

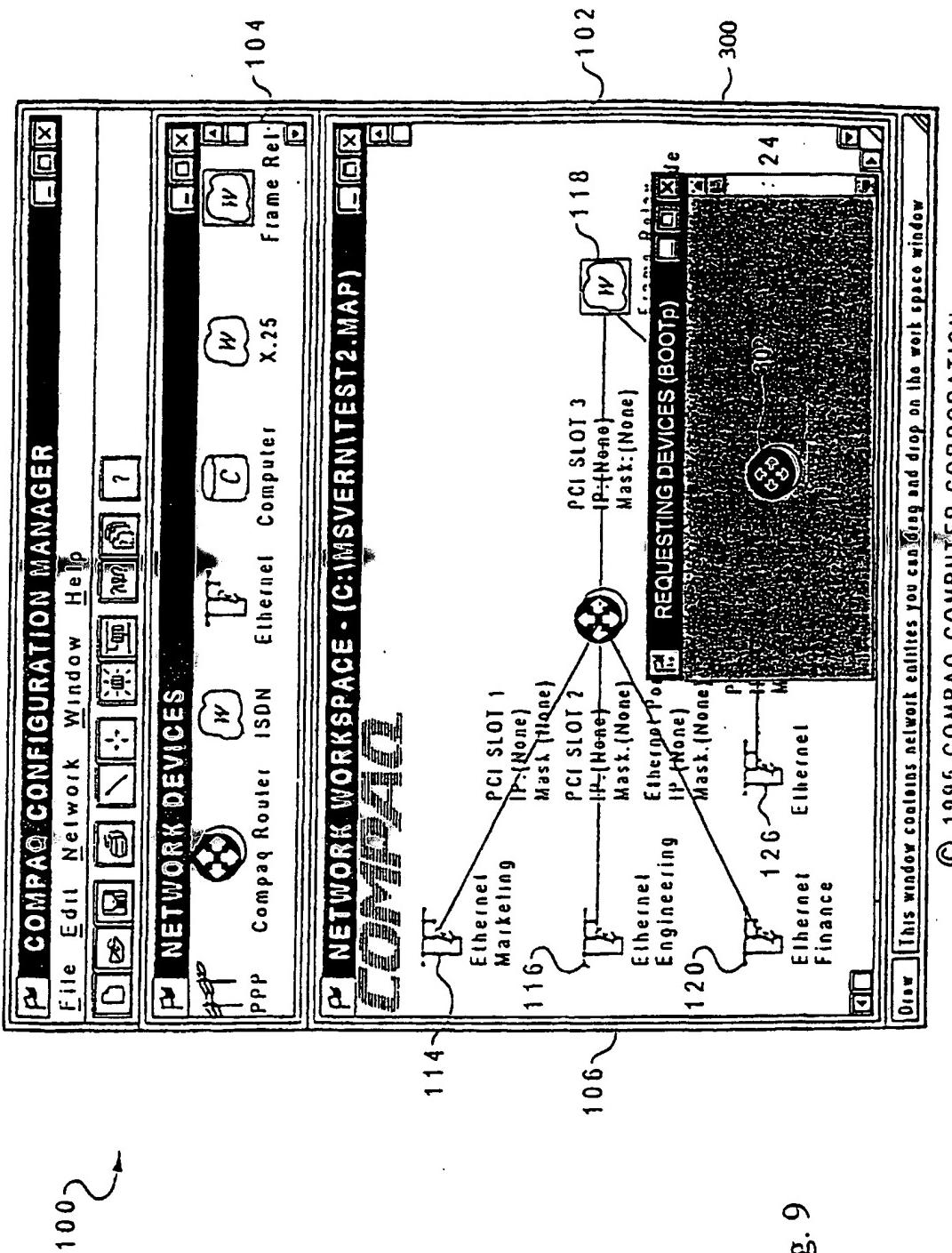


Fig. 9

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